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THE ONE-HUNDREDTH ANNIVERSARY OF THE UNITED STATES COAST AND GEODETIC SURVEY

ACCOUNT OF THE CELEBRATION

IN eighteen hundred and sixteen the United States Coast Survey was organized under Mr. Ferdinand Rudolph Hassler, as superintendent, and field work was begun.

This event was fittingly celebrated in Washington on the fifth and sixth of April last by public meetings in the auditorium of the New National Museum at Washington at which papers were presented by representative men in the fields of science, engineering, commerce, government and military affairs.

The celebration closed with a banquet at the New Willard Hotel, the evening of the sixth, at which the President of the United States was the principal speaker. The other banquet addresses were by the Secretary of the Navy, the Secretary of Commerce, the minister of Switzerland, and former superintendent of the Survey, Dr. T. C. Mendenhall.

The superintendent of the Survey, Mr. E. Lester Jones, presided at the banquet and at the three public sessions at the museum. He opened the session with well-chosen remarks and was followed by Mr. Redfield, Secretary of Commerce, the department of which the Survey is a bureau. Mr. Redfield paid a tribute to the valuable work done by the members of the Survey during the hundred years of its existence. He made a plea for support from the public and from Congress in order that the Survey might greatly extend its usefulness to the science, industries, commerce and defense of the nation.

The program of papers presented at the general sessions was given on page 421 of SCIENCE of March 24, 1916. The paper by Admiral Pillsbury was read by title only, as he was ill and not able to appear. Each of the papers presented some particular phase of the survey's activities and in a number of cases there was shown how its work was related to that of some of the other organizations of the government.

The address by President Wilson at the banquet, the paper of Dr. George Otis Smith and abstracts of the other papers and addresses follow this brief account of the celebration.

A very interesting feature of the celebration was an elaborate exhibit of the instruments, charts and publications of the survey, some of them dating back to the earliest years of its history. A series of enlarged photographs showed in a very clear and impressive way the modern field operations of the survey.

The proceedings at the celebration, including the addresses delivered, will be published in one volume by the survey.

WILLIAM BOWIE

ADDRESS OF THE PRESIDENT OF THE UNITED STATES

Mr. Minister, Mr. Superintendent, Ladies and Gentlemen: I had another reason for asking to come last. I remember reading with appreciation in the preface of a volume of essays written by a very witty English writer a passage to this effect: The pleasure with which a man reads his own books is largely dependent upon how much of them has been written by somebody else; and I have found that my enjoyment of making speeches after dinner is almost directly in proportion to the amount of inspiration that I can derive from others.

It was manifestly impossible for me to make such preparation for addressing you to-night as I should have wished to make in order to show my very great respect and admiration for this service of the government. I can only say that I have come here for the purpose of expressing that admiration. I have been very much interested in the speeches that I have heard to-night, not only because of what they contained, but also because of many of the implications which were to be drawn from them. I was very much interested indeed in the excellent address of the representative of the free and admirable republic of Switzerland. He reminded us of what we must constantly remember, our very great intellectual debt to Switzerland, as well as to the many other countries from which we draw so much of our vitality and so much of the scientific work which has been accomplished in America.

As he was speaking, I was reminded (if there are Pennsylvanians present, I hope they will forgive this story) of a toast mischievously offered at a banquet in Philadelphia by a gentleman who was not himself a Pennsylvanian. He said he proposed the memory of the three most distinguished Pennsylvanians, Benjamin Franklin, of Massachusetts; James Wilson, of Scotland, and Albert Gallatin, of Switzerland. I dare say that in many American communities similar toasts could very truly and with historical truth be offered. And I myself had the privilege of sitting under one of the distinguished Swiss scholars to whom reference was made, Dr. Arnold Guyot, under whom I pretended to study geology. Doctor Guyot was not responsible for its not being carried beyond the stage of pretence.

I feel myself in a certain sense in familiar company to-night, because a very great part of my life has been spent in association with men of science. I have often wished, particularly since I entered public life, that

there was some moral process parallel to the process of triangulation, so that the whereabouts, intellectually and spiritually, of some persons could be discovered with more particularity. Yet as I listened to the Secretary of Commerce, I suspected that he was priding himself upon the discovery of a process by which he had discovered the whereabouts of a great many committees of Congress and a great many other persons connected with the process of appropriating public moneys. I have a certain sympathy with those committees of Congress which in investigating the Coast and Geodetic Survey have found that the superintendent had the great advantage of knowing all about the service and they the great disadvantage of knowing nothing about it. because, as I have said, I have spent a great part of my life in association with men of science and, never having been a man of science, I have at least learned the discretion of keeping my opinions on scientific subjects to myself.

I have had association particularly with the very exact and singularly well informed brother of a distinguished gentleman present. General Scott has a brother who is a member of the faculty of Princeton University, and Professor William B. Scott is one of the most provoking men I have ever known. He not only asserts opinions and delivers himself of information upon almost every subject, but the provoking thing about him is he generally knows what he is talking about. A good talker who volunteers opinions on all subjects ought to be expected in fairness to his fellow men to make a certain large and generous portion of mistakes, because you can at least catch him napping, but Professor Scott is one of those men who successfully—I have sometimes told him I suspected adroitly—avoided the pitfalls of eminent conversationalists like himself; but association with such men has taught me a very great degree of discretion and, therefore, I am not going to express any opinion whatever about the work of the Coast and Geodetic Survey. But I am going to give myself the privilege, for it is a real privilege, of saying this:

This is one of the few branches of the public service in which the motives of those who are engaged can not be questioned. There is something very intensely appealing to the imagination in the intellectual ardor which men bestow upon scientific inquiry. No social advantage can be gained by it. No pecuniary advantage can be gained by it. In most cases no personal distinction can be gained by it. It is one of the few pursuits in life which gets all its momentum from pure intellectual ardor, from a love of finding out what the truth is, regardless of all human circumstances—as if the mind wished to put itself into intimate communication with the mind of the Almighty itself. There is something in scientific inquiry which is eminently spiritual in its nature. It is the spirit of man wishing to square himself accurately with his environment, not only, but also wishing to get at the intimate interpretations of his relationship to his environment; and when you think of what the Geodetic Survey has been attempting to do —to make a sort of profile picture, a sort of profile sketch, of the life of a nation, so far as that life is physically sustained—you can see that what we have been doing has been, so to say, to test and outline the whole underpinning of a great civilization, and just as the finding of all the outlines of the earth's surface that underly the sea is a process of making the pathways for the great intercourse which has bound nations together, so the work that we do upon the continent itself is the work of interpreting and outlining the conditions which surround the life of a great nation.

I can illustrate it in this way, the way in

which it appeals to my imagination: I have always maintained that it was a great mistake to begin a history of the United States intended for beginners by putting at the front of the book a topographical map of this continent, or at any rate of that portion of it which is occupied by the United States, because if you begin with that, you seem to begin to deal with children when you deal with the first settlers. They know nothing about it. They expected to find the Pacific over the slope of the Alleghanies. They expected to find some Eldorado at the sources of the first great river whose mouth they entered upon the coast. They went groping for the outlines of the continent like blind men feeling their way through a jungle. They were as big men as we, as intelligent; they had as full a grasp upon the knowledge of their time as we have upon the knowledge of ours; but set the youngster in the school to watch these men groping, and he will get the impression that they were children and pygmies. That is not the way to begin the history of the United States. You will understand it only if you comprehend how little of what the work of this department of the government, for example, has since disclosed, was known to those then engaged in this great romantic enterprise of peopling a new continent and building up a new civilization in a new world.

So that you have the picture of a service like this lifting the curtain that before that time rested upon all the great spaces of nature. You remember how in the early history of Virginia a little company of gentlemen moved by a sort of scientific curiosity, and yet moved by a spirit of adventure still more, penetrated no further than to some of the unknown fastnesses of the Alleghany Mountains and were thereafter known as the Knights of the Golden Horseshoe—given a sort of knighthood of adventure because they went a little way upon the same quest upon which you gentlemen have gone a great way.

So when I stand in the presence of scientific men I seem to stand in the presence of those who are given the privilege, the singular privilege, the almost contradictory privilege, of following a vision of the mind with open, physical eyes; making real the things that have been conjectural; making substantial the things that have been intangible.

And as the Secretary of Commerce has said, there is a great human side to the things that you are doing. You are making it safe to bind the world together with those great shuttles that we call ships that move in and out and weave the fabric of international intercourse. You are providing the machinery by which the web of humanity is woven. It is only by these imaginative conceptions, it is only by visions of the mind, that we are inspired. If we thought about each other too much, our little jealousies, our rivalries, our smallnesses, our weaknesses, there would be no courage left in our hearts.

Sometimes when the day is done and the consciousness of the sordid struggle is upon you, you go to bed wondering if the sun will seem bright in the morning, the day worth while, but you have only to sweep these temporary things away and to look back and see mankind working its way, though never so slowly, up the slow steps which it has climbed to know itself and to know nature and nature's God, and to know the destiny of mankind, to have all these little things seem like the mere mists that creep along the ground, and have all the courage come back to you by lifting your eyes to those blue heavens where rests the serenity of thought.

THE UNITED STATES GEOLOGICAL SURVEY AND ITS RELATION TO THE UNITED STATES COAST AND GEODETIC SURVEY[1]

THE relations of near relatives may be a delicate subject for public discussion. The two organizations of which I have been asked to speak this afternoon possess the same family name as well as certain family characteristics and in consequence are often mistaken one for the other. If one Survey buys a motor truck the other gets the benefit of the advertising and the curious public remarks: "We don't see how the Geological Survey can afford it."

Yet the relations of the two Surveys have been such for more than a third of a century, and are such to-day, that I welcome this opportunity for the younger to extend congratulations to the older organization. Were I to review in detail the common history of these two Surveys there are no chapters that I should better omit nor incidents that I might need to gloss over in order that my remarks be in keeping with the spirit of this occasion. In short, the hearty congratulations that I bring are an expression of true appreciation of what the United States Coast and Geodetic Survey has been to the United States Geological Survey.

The two bureaus have much in common; the field of endeavor for each is nation-wide; they are scientific in spirit and civil in organization; both are primarily field services, and the product of most of the work of each reaches the public in the form of maps. The similarity in official name also indicates a certain overlapping of function, which under some conditions might cause duplication of work. The fact that at no point in the twilight zone of superimposed jurisdiction has there been any wasted effort is good evidence that both these branches of the federal scientific service have kept in mind the public nature of their work. It is because I realize that in the interrelations of these two bureaus the Geological Survey has been more often the beneficiary that I desire on this occasion to emphasize this gratifying fact that the two Surveys have worked in the cause of American science on a coordinated rather than a competitive basis.

In this connection I should mention the effort made thirty-seven years ago to put on an economic and efficient basis the surveying work in the Western States. Under instructions by Congress the National Academy of Sciences considered all the work relating to scientific surveys and reported to Congress a plan prepared by a special committee, whose membership included the illustrious names of Marsh, Dana, Rogers, Newberry, Trowbridge, Newcomb and Agassiz. This report, which was adopted by the academy with only one dissenting vote, grouped all surveys, geodetic, topographic, land-parceling and economic, under two distinct heads—surveys of mensuration and surveys of geology. At that time five independent organizations in three different departments were carrying on surveys of mensuration, and the academy recommended that all such work be combined under the Coast and Geodetic Survey with the new name Coast and Interior Survey. For the investigation of the natural resources of the public domain and the classification of the public lands a new organization was proposed—the United States Geological Survey. The functions of these two Surveys and of a third coordinate bureau in the Interior Department, the Land Office, were carefully defined and their interrelations fully recognized and provided for in the plan presented to Congress. Viewed in the light of thirty-seven years of experience, the Na-

[1] Centennial exercises of the U. S. Coast and Geodetic Survey, April 5, 1916.

tional Academy plan would be indorsed by most of us as eminently practical, and I believe the report stands as a splendid example of public service rendered by America's leading scientists. The bill which embodied the entire plan, however, failed of passage in Congress, although the part relating to the organization of the new Geological Survey was carried as a rider on the Sundry Civil Appropriation Act of March 3, 1879.

The newly organized United States Geological Survey began topographic surveys of the type that the National Academy had believed could best be executed by the Coast and Geodetic Survey, and the younger Survey has continued this kind of mensuration surveying until it has covered more than 40 per cent. of the country and become the principal map-making bureau of the government. In course of time also more or less legislative authority has been given for the control work, vertical and horizontal, needed for these topographic surveys, so that there has been evolved exactly the opportunity for duplication of work that the National Academy sought to prevent. The invitation to speak this afternoon on the subject of the relation of the United States Geological Survey to the United States Coast and Geodetic Survey is a privilege that I value highly because it gives me the opportunity to point out that the result that Congress failed to insure by legislation has been attained by voluntary scientific cooperation.

In topographic mapping the activities of the older bureau stop at the coast, as its name suggests; its mensuration surveys elsewhere are purely geodetic and represent a refinement of method and an accuracy of result that is not necessary in the ordinary mapping of the country as a whole, although these engineering results are absolutely essential. Members of the Geological Survey most familiar with these large contributions by the Coast and Geodetic Survey have estimated that the value of the geodetic work done by the older organization that would otherwise have necessarily been done by the Geological Survey has aggregated not less than a million dollars, and if the future engineering work of the Coast and Geodetic Survey as now planned is carried to completion another million dollars should be included in our total indebtedness to the older Survey.

The United States Geological Survey is proud of its pioneer work in aid of the development of the resources of Alaska, yet we are not forgetful of the fact that the real pioneer in Alaska was the United States Coast and Geodetic Survey, which started its work in Alaska thirty years earlier than our own Survey.

It has been the custom of each of these Surveys to supply the other with photographic copies of field sheets of current work, and I am glad to record the fact that cooperation of this type has not been one-sided. Our topographic survey of the Bering River coal fields, for instance, yielded data that were incorporated in the important Coast Survey chart of Controller Bay, which was published before the Geological Survey issued its topographic map of the larger area. In this way the public was served by receiving the information earlier than if the Geological Survey had insisted upon first publishing its own results. The testimony of the members of the Alaskan division of the Geological Survey is that the cooperation in Alaska has been as hearty and close as if the Coast and Geodetic Survey men and the Geological Survey men belonged to the same bureau.

In this connection too should be mentioned the earlier geologic observations made in Alaska by members of the Coast and Geodetic Survey, and chief among

these scientist pioneers in Alaska is our own Dr. Dall, the credit for whose half century of scientific work under government auspices is shared by the Coast and Geodetic Survey and the Geological Survey. In connection with its engineering work also, the Coast and Geodetic Survey has made important scientific contributions that are distinctly geologic in character, and as geologists we are almost inclined to lay claim to Hayford's work on isostasy and Bowie's gravity determinations.

Every geologist who works in that attractive borderland where both the products of geologic processes and the processes themselves can be studied side by side—our Continental shore line—has made large use of the Coast and Geodetic Survey charts, and as competent witnesses we gladly testify to the accuracy of these charts and we compliment their makers. Such geologic investigations as the study of changing shore lines, the history of the submerged margins of the continent, and the origin of sediments are being given attention by the Geological Survey, and all these studies must be based upon the surveys and resurveys made by the Coast and Geodetic Survey.

This brief review of the relations existing between these two bureaus may serve a larger purpose than the sincere expression of congratulations to the Coast and Geodetic Survey on this centennial occasion. For nearly four decades these two Surveys have been working side by side from Florida to Alaska without the specific statutory separation of functions deemed advisable by the National Academy and therefore with full opportunity to overlap their fields of operation, to duplicate work, and thus to waste public money. The fact that there has resulted economical coordination rather than wasteful competition stands to the credit of those in administrative control of the two bureaus, especially the superintendents and directors of the earlier years of this period of successful cooperation. Naturally too the spirit of hearty cooperation is equally shown between the scientific assistants of the two services.

In these days, when as American citizens we have so deep concern in the question of public regulation of private business—a nation-wide concern arising from a broadening appreciation of society's interest in the individual—it may be opportune for some of us as public officials to pause and consider the question of regulation of public business. Do we apply the same rules to our conduct of the business of these federal bureaus that we advocate for the control of corporations? Some of us as scientists may feel that the comparison of a scientific bureau with an industrial corporation is forced if not absurd. Yet I trust that the two are alike in being not only productive but productive without undue waste. The National Academy report of 1878 to which I have referred contains a significant phrase: in presenting to Congress the ideal for a scientific bureau as they saw it these scientists described the ideal plan as one that would yield the "best results at the least possible cost." Those few words express a practical administrative policy equally good for big business and pure science. And it is as illogical for a scientific bureau as for a munitions plant to shy at a cost-keeping system.

Here at the federal capital we have some two score scientific bureaus distributed through several executive departments. There exists no general plan of division of duties among these different agencies for public service, but as a fundamental policy we have pinned our faith to a sort of declaration of independence that all scientific bureaus were created free and equal. My acquaintance with bureau chiefs and their intimate advisers perhaps warrants

me in describing them as possessing at least average ambitions, with the inevitable result that we have seen some field of scientific investigation occupied by two or more bureaus, other and less attractive fields shunned, and even other fields claimed by those bureaus not best qualified to make the largest use of the opportunity for creative work. Among ourselves, we know of so many illustrations that no examples need be cited; each of us no doubt feels sure that he can at least specify the sins of other bureaus. This is the competitive system almost at its worst, because it is countenanced by men of scientific training and high ideals of public service. Fortunately, however, the two bureaus of which I have particularly spoken, as well as some others, furnish proof that there can be coordinated effort in federal scientific work.

I have here referred to the business world, because I believe we must apply some of the same rules to our scientific work. However slight may be the statutory limitations imposed by Congress upon these scientific bureaus, we can not escape the requirements of economic law, which is never a dead letter, although too often unread. If in the world of private business the competitive system sometimes breaks down and fails to protect the public, so in our narrower circle of public business there may be a similar failure of competition to produce the best results. The question is always fair and is sometimes pertinent, How far should these government scientific bureaus go in seeking to enlarge their field of usefulness? Does this competitive spirit by its appeal to individual ambitions make for better public service? To what extent is it good public policy to have the public servants on the *qui vive* for new opportunities to serve, new worlds to discover, new appropriations to get? Service and discovery are the proper ideals of the individual investigator, but should even ideals justify trespass and disregard of others?

First of all, we must agree that however great its advantage as a method of stimulating progress, competition must be always fair. If we are to apply the principles of the Sherman Act and the Clayton Law to public business, unfair methods must be ruled out as illegal. I do not believe my comparison is a forced one. You can read decrees of the federal courts that prohibit corporations from doing things that are somewhat similar to practises of which we ourselves have been guilty. In one case, among other items, the defendant corporation was enjoined from making false representations concerning competitors and from hiring away employees of competitors—simply a twentieth-century echo of the ninth and tenth commandments of the Mosaic law, especially the edict against coveting thy neighbor's man-servant. In the public service proper coordination of work often makes transfers from one bureau to another desirable, and so as a means of increasing efficiency such transfers are and should be welcomed, but efficiency from the larger view is attained only when the interests of both bureaus are considered, in which event the individual also profits by his larger opportunity. With science alive and expanding in so many directions, subdivision and redistribution of functions makes certain interbureau transfers of specialists absolutely necessary.

Another unfair practise, not countenanced by the courts in their regulation of private business, is tricky advertising as a method of meeting real competition. Honest advertising must be founded on truth, and even scientific bureaus may need sometimes to apply this acid test to the statements they give out to the public. Scientific investigations whose purpose is to increase human knowledge do not find their

best expression in publicity whose principal object is to impress the Appropriation Committee. Such advertising may have its foundation in truth and yet may possess a superstructure so large and top-heavy as to violate all engineering formulas.

Unrestrained competition in the public service, then, presents some dangers no less real than those incident to unregulated competition in private business. The question must come home to every bureau chief and to his intimate advisers: To what extent is a competitive struggle for new territory warranted, even when only fair methods are used in this endeavor for bureaucratic expansion? I am aware that we may invoke "the public demand" and put forward other equally plausible reasons, but even if we sometimes fool Congress and on rare occasions fool each other, we never fool ourselves. Of course the individual investigator, self-centered with enthusiasm in his discovery of a new line of research, may be wholly ignorant of the fact that among the two thousand or so fellow scientists here in Washington, some one in another department has already preempted that subject and possibly carried the work well on to completion; but however unconscious the scientific worker in one bureau may be of the obvious relation of that problem to the work of some other bureau, only rarely indeed can his own bureau chief plead any such ignorance or innocence. May I express my individual conviction that the bureau chief who makes strategic moves in this contest for enlargement of field of work is just as conscious whether he is playing the game fairly as the "captain of industry" that we have thought ought to be investigated by the Department of Justice.

Even at its best, however, this competitive system is wasteful. The public has too often found that competition as the safety-valve of business costs too much in steam. If in the branch of public business in which we are engaged the ideal is to render the best service at the lowest cost, must there not be regulation, and regulation which recognizes that there are what we may term natural monopolies in the government scientific service? The monopolistic idea must here yield the same real savings to society that have come with the recent growth of public-utility monopolies. The product of our scientific bureaus is not a staple commodity, but a special service to the public, and under governmental auspices this service is offered without price, yet that does not mean that we are any less vitally interested in costs. If monopoly will enable these scientific bureaus to render the best service at the lowest cost, the competitive system in scientific work should go to the scrap heap as out of date.

The adoption of the monopoly system, however, involves here, as in the field of public utilities, the correlative idea of adequate regulation in the public interest. And here is where we may be in danger of losing our way, for the question of course obtrudes itself: Who is the guide; who is to define the field of work to be monopolized by this or that bureau? My own belief is that Congress can not be expected to enforce even its own wishes in the matter. Some years ago the chairman of a Congressional committee that had made a most thorough investigation of one of the departments, himself a trial lawyer of large experience, admitted to me that the investigation had been largely in vain; in his own words, "I know the department is full of duplication, but it would take a trained scientist to put his finger on it all." Nor can the cabinet officer be expected in a few years to discover all the overlaps in his own department, much less to learn the logical and proper coordination of the scientific

work in several departments. Thus the responsibility in large measure falls back upon the bureaus themselves—they must provide that careful coordination which precludes wasteful competition and promotes helpful cooperation. To return for a moment to my text, I do not know that the successful coordination of the work of our two Surveys has been due in any large degree to the influence of Congress, although my experience is that appropriation committees do watch these details, nor have I ever known any Secretary of the Interior or of the Treasury or of Commerce to define this wise policy; the happy result must be credited rather to a small group of administrative chiefs in each of these two scientific bureaus.

The obligation for the proper conduct of the scientific work of the government, therefore, can not be lifted from the shoulders of the bureau chiefs and their immediate associates in the work of administration. Moreover, this responsibility is a double one —we should feel not only the duty as public servants to avoid wasteful use of the public money, but also the obligation as scientists to conserve scientific effort by preventing duplication in research and in publication. Aside from the absurdity that lies in the spectacle of bureau chiefs trying to impress congressional committees, do we not by our acts suggest a lack of faith in science itself? We talk impressively of the day of highly specialized science and then go out and poach on what is properly the domain of others. Since the days of Aristotle students of politics have recognized as a weakness in democracies the habit of not appreciating the value of trained specialists. Within a few weeks the *London Financial News* remarked editorially upon the national neglect of science to which is now attributed the bulk of the British failures under the test of war. But as self-labeled scientists are we not ourselves similarly lacking in our appreciation of the value of science and of scientific organization in so far as we fail to recognize that by reason of its experience and its personnel some other bureau, even in another department, can better handle a certain subject than our own bureau. Especially when a new idea is before the public are we apt to be temporarily blinded by its popularity and thus lose sight of the eternal fitness of things. I can best illustrate this by mention of a current topic. The fixation of nitrogen is a matter of national importance; plainly the military departments are most concerned by reason of their need of nitric acid for munitions, yet as against any claims of the War and Navy Departments must be set the fact that nitrogen is one of the essential elements in fertilizers, and its production is therefore of vital concern to the Department of Agriculture; however, the mineral deposits necessary to the fixation process are to a large extent under the jurisdiction of the Department of the Interior, not to mention some of the most available power sites; nor must I overlook the fact that this subject was first investigated and reported upon by a bureau in the Department of Commerce. So the competitive contest is on, but the obviously most reasonable consideration is still in the background. What department or bureau, if any, has already on its rolls the force of hydraulic and construction engineers ready to begin the preliminary studies and surveys and the organization already adapted to push the construction of the plant, should Congress authorize this innovation in governmental activity? As evidence of my good faith in mentioning this illustration, let me add that an investigative bureau like the Geological Survey is not organized on a plan at all adapted to the construction and operation of an industrial plant; and all that I may

claim for our bureau in this connection is that we sometimes recognize the obvious.

Those of us who have been responsible for the work of securing the needed appropriations are at times likely to have our judgment warped by what we think are the exigencies of the case. A member of a scientific bureau was once so concerned for the success of his bureau that he even recommended its transfer to another department so as to get under the wing of a more generous appropriation committee. The logic of the situation does not always appeal to us, and we are willing for the moment to sell our birthright for a larger appropriation. The obvious fact in this matter of the interrelations of the scientific bureaus of the government is that if the bureau chiefs do not always exhibit an appreciation of the proprieties in scientific investigation nor seem to possess much idea of perspective in the alignment of boundaries, can even the most experienced legislators be expected to make the best distribution of scientific work?

The possession by any bureau of even a skeleton organization of efficient specialists in a certain field would seem to be the practically unanswerable argument for entrusting to that bureau any new and enlarged work in that field whenever Congress deems larger appropriations advisable. That is the type of practical logic that is recognized in private business, for under public regulation of natural monopoly the public-utility company that first enters the local field is recognized and even protected by the public-service commission, as long as the service rendered is at all adequate. In the business world the day of preferment of special applicants in the granting of municipal franchises has passed, and in our government business there is no better reason for granting special privileges to overzealous bureau chiefs. I sometimes think that the bureau chief comes nearer being safe and sane in his public acts and utterances in the intervals between sessions of Congress.

In this informal comparison of the actual and the ideal in the administration of the scientific bureaus of the government, I have had ever in mind the existence of a real basis for optimism in the splendid record of the Coast and Geodetic Survey and the Geological Survey in absolutely coordinating their endeavors in the public service. And I desire simply to add that this practical cooperation has been so easily accomplished that it is only as we review these several decades of joint work and estimate the value of the reciprocal services rendered that we realize how ideal have been the relations between the two Surveys.

GEORGE OTIS SMITH
U. S. GEOLOGICAL SURVEY

ABSTRACTS OF ADDRESSES AT THE CENTENNIAL EXERCISES OF THE U. S. COAST AND GEODETIC SURVEY

APRIL 5, 1916

The Bureau of Fisheries and Its Relation to the United States Coast and Geodetic Survey: DR. HUGH M. SMITH.

Long before the Coast and Geodetic Survey and the Bureau of Fisheries were adopted by the same mother department and thus became sisters; in fact as early as 1873, when the former had already attained a robust maturity and the latter was still in swaddling clothes, there began close cooperative relations. These have continued up to the present time and have increased in intimacy and value in more recent years since the two establishments became members of the same official family. It is only fair to acknowledge that at first the cooperation was very one-sided, consisting largely of the bestowal by the Coast and Geodetic Survey of substantial favors in return for profuse thanks. From 1880, when the Bureau of Fisheries began to acquire vessels of its own, that service began to repay, in part at least, some of its obligations, and ultimately it contributed substantially to the published records of the Survey. The former has always depended on the latter for its

basic triangulation whenever a biological survey of any kind has been undertaken in a region in which the Coast Survey has operated, which of course means anywhere on the coast of the United States. On the other hand, the hydrographic and topographic results of this biological work have always been made available to the survey.

On both the Atlantic and Pacific coasts a considerable part of the offshore soundings found on the charts was determined by the steamers *Fish-Hawk* and *Albatross* in pursuance of their fishery investigations, and some of the inshore data of certain of the earlier charts came from reconnoissances by the *Albatross*. While much of the latter has been superseded by more accurate work as the Coast Survey was able to extend its operations, it served a good purpose for some years. Later there came into the command of these two vessels naval officers who had been trained in the survey, with resulting improvement in the character and accuracy of the fishery surveys, not only those under their immediate direction, but throughout the service. I can not let this opportunity pass without paying humble tribute to the distinguished labors in behalf of oceanic physics and biology performed by men like Z. L. Tanner and J. F. Moser, who, while retaining their naval status, commanded fishery vessels, and collected invaluable material for the Coast Survey.

The gathering of hydrographic and other data for use of the Coast and Geodetic Survey by the steamer *Albatross* has been particularly extensive in the Pacific Ocean and along the west coast of America.

Work Done by the United States Coast and Geodetic Survey in the Field of Terrestrial Magnetism: Dr. L. A. Bauer.

From the earliest days of the establishment of the Coast Survey, magnetic observations for the prime use of the surveyor and of the mariner were considered a legitimate and useful part of its work. In the "Plan for the Reorganization of the Survey of the Coast," as adopted in 1843, explicit provision was made for the making of "All such magnetic observations as circumstances and the state of the annual appropriations may allow." Since then Congress, by annual appropriations, has continuously and increasingly recognized the importance of this feature of the work of the survey, so that in 1899 an enlarged appropriation made it possible to carry out a magnetic survey of the whole United States on a systematic basis, and with an expedition theretofore not possible.

When the first chart of the lines of equal magnetic declination, known to the surveyor and the mariner as the lines of equal variation of the compass, was issued by the Coast Survey in 1855, the number of available stations at which magnetic observations had been made amounted to about 150, and these were distributed very irregularly and covered but a limited region of our country. At the close of 1915 the number of these stations was 5,000, the stations now being distributed fairly uniformly over the United States. Besides, a vast amount of magnetic data has been compiled from other sources and the survey has also made magnetic observations at some 500 stations in our outlying possessions. The average distance apart of the places at which accurate magnetic observations have now been made in the United States is about 25 miles. Meridian lines for the use of surveyors have been established at many county seats throughout the country, magnetic data at sea have been accumulated on cruises of the Coast Survey vessels, and five magnetic observatories, where the countless fluctuations of the earth's magnetism are being continuously recorded, are at present in operation under the direction of the survey.

The contributions of the Coast and Geodetic Survey to the advancement of our knowledge in terrestrial magnetism, in fulfilment of both practical and scientific demands, have been unexcelled by any other national organization. Because of its extensive compilations of data relating to the change of the compass direction from time to time, the Coast and Geodetic Survey is able to furnish promptly information of priceless value in the adjudication of disputed land boundaries, the bearings of which were referred to the compass direction when originally laid out, 100 to 150 years or more ago.

The changes in the compass direction reach very appreciable amounts with the lapse of time. The compass even changes its direction between morning and afternoon by an amount appreciable in accurate land surveying. During a so-called magnetic storm, the compass direction may change suddenly by a degree or more. All such fluctuations are recorded at the magnetic observatories of the survey, and the information is published promptly, and made readily accessible to all interested.

The assumption frequently made by surveyors that the compass has changed its direction regularly at the rate of 3 minutes per year or 1 degree in 20 years, is not borne out by the data of the survey. At the present time, for example, in the New England states the north end of the com-

pass is moving west at the rate of about 6 minutes per annum. In Porto Rico this westerly motion is as much as 10 minutes, and along the northeastern coast of Brazil it is about 16 minutes. Thus, instead of a change of 1 degree in 20 years, there may be a change of 1 degree in 10 years or even in 5 years or less, depending entirely upon geographic location.

The Bureau of Standards and its Relation to the United States Coast and Geodetic Survey: DR. S. W. STRATTON.

The speaker sketched the history of the various standards which have been used in this country. He paid a high tribute to Mr. Hassler for creating the division of weights and measures of the survey. This division became in 1904 the present Bureau of Standards, a separate organization. He spoke of the close cooperation which has always existed between the Bureau of Standards and the Coast and Geodetic Survey.

Ocean Currents and Deep Sea Explorations of the United States Coast and Geodetic Survey: REAR ADMIRAL J. E. PILLSBURY.

After mentioning the early voyagers who came in contact with and noticed the Gulf Stream, a brief description was given of the first American investigation, that of Benjamin Franklin. On his voyages to and from Europe—and there were many—he observed the temperature of the water in the endeavor to determine the northern limit of the stream issuing from the Straits of Florida under the theory that the warmer water indicated its boundary.

It was not until 1845 under the administration of A. D. Bache that the Coast Survey began a systematic study of the Gulf Stream. From that year until 1853 many vessels were engaged in the work under the most comprehensive orders. They were to determine its limits, surface and subsurface, whether constant or variable, whether depending upon winds and how recognized, whether by temperature, soundings, vegetable or animal life, specific gravity of its water, etc.

In 1867 Professor Henry Mitchell, of the Coast Survey, began an investigation of the Gulf Stream by a new method. He sounded between Key West and Havana and observed currents to 600 fathoms by means of floating cans, or weighted cans suspended from floating cans.

The survey also used ballasted bottles to determine the course of the currents. Each one when it was put overboard contained a paper with a request to the finder to send it to some American official and to mark on it the place where it was found.

In 1883 the first attempt was made to investigate the actual flow of the Gulf Stream by a vessel at anchor, when the schooner *Drift* under Lieutenant Fremont anchored with wire rope and observed the currents between Jupiter Inlet, Florida, and Memory Rock, Bahama.

The results were of so great value that the Superintendent decided to continue the work, but the use of a sailing vessel for the purpose was considered impracticable. The time spent in reaching the anchorage and the hours required in anchoring and in getting under way by the use of hand power alone necessitated the selection of a vessel with steam for the purpose. The *Blake*, under Lieutenant Pillsbury, was the vessel chosen, and during the following five years she was engaged in Gulf Stream work each winter season and some summers. Anchorages were made in any depth required; many being in water deeper than 1,500 fathoms, and the deepest in 2,300 fathoms. The longest time at any one station was about seven days, and by the use of an instrument devised for registering the direction as well as the velocity of the currents, observations were carried on as long as the vessel remained at anchor.

As to results, it was found that the velocity of the Gulf Stream varied daily, according to the moon's transit, and monthly following its declination, and that these variations could be predicted with fair accuracy. A calculation as to its volume, deduced from many hundreds of observations in the narrowest part of the Straits of Florida, gave 90,000,000,000 tons per hour.

The United States Geological Survey and its Relation to the United States Coast and Geodetic Survey: DR. GEORGE OTIS SMITH. Printed in this issue of SCIENCE.

The United States Coast and Geodetic Survey's Part in the Development of Commerce: HON. J. HAMPTON MOORE.

Mr. Moore spoke of the relation of the Coast and Geodetic Survey to Commerce and after paying high tribute to the perseverance and loyalty of the men of the service, said that commerce itself did not fully appreciate the importance of the work. Amongst other things, he referred to the formation of shoals and the location of rocks that impede navigation.

"I am interested in the safety of life and commerce on all our coasts, but by reason of familiarity with the Atlantic coast, I may be pardoned for

calling attention to a few of its needs. Suppose some day, as many experts think probable, the Caribbean Sea should become the base of a great naval warfare. Florida undoubtedly would become a center of American activities. Her inland waterways, so far as they are fit, would be serviceable for supply and munition ships, and for small vessels of the navy. We can not count too much on these waterways now, for they have not been improved as they should have been. But what layman ever knew, or knows now, that the Coast and Geodetic Survey has 172,000 square miles of hydrographic surveying ahead of it before all sides of Florida are covered.

Our needs by way of protection against reefs and shoals around the Florida coast are far more extensive than they are in the Alaskan waters, and yet in Alaska but eight per cent. of the navigable waters have been surveyed to the satisfaction of the bureau.

The dangers of Cape Hatteras are known to every American, and the currents that abound on that treacherous coast demand the frequent inspection and oversight of the chart-makers. Just above Hatteras, along the North Carolina coast, the shore line is constantly changing, as is well known. Inlets close and open according to the whims of nature. It is an interesting historical fact that no living man is now able to locate the inlet through which passed the Sir Walter Raleigh expedition, which made the first English settlement on Roanoke Island in 1584. That the vessels of Amadis and Barlow entered Croatan Sound is well established, but the channel through which they came has long since disappeared.

The closing of inlets as far north as New York has not been of infrequent occurrence in the course of the last century, nor has the accretion or recession of land where the waves and storms have played upon it.

Near Chincoteague Inlet, Virginia, is a comparatively new harbor, known as the Assateague Anchorage. It owes its existence to a natural change in the coast line at the south end of Assateague Island, which has converted an exposed bight into a well-protected and much frequented harbor. This harbor is preferred by local shipping to some of the artificial harbors of refuge along the coast. It has an added importance because it is the only harbor between the entrances to the Chesapeake and Delaware bays, but it must be examined frequently in order that the shifting sands may be so charted as not to deceive the mariner.

Advancing along the coast to the New Jersey and Delaware shores, where shipping increases, it is observed that at the present time the Coast and Geodetic Survey stands in need of funds to survey and resurvey about 13,000 square miles off shore. There are shoals constantly forming on these shores which should be examined and charted in the interests of navigation. This is an area which is presumed to have passed the pioneer stage, but it evinces that same disposition to conform to the forces of nature that prevail in less frequented waters.

More remarkable than this, however, is the situation with respect to the waters approaching the great metropolis of New York. The Rivers and Harbors bill, now pending in the House of Representatives, carries an appropriation of $700,000 to extend and deepen the channel from the sea to the Brooklyn Navy Yard, a very important work that should have been completed long ago. The reason for this appropriation is that there are obstructions in the channel, possibly of rock foundation, which make navigation perilous for the dreadnaughts of the navy. When vessels of 12 feet draft were sailing into New York harbor it made no difference about this channel, but the increase in the size and draft of vessels has made a difference, and the lead and the drag must be invoked again.

There are rocks in the East River, as every one knows. Some of them are of the pinnacle type, and strange as it may seem have only recently been located. As late as 1915 the wire drag was used by the Coast and Geodetic Survey in the East River, locating certain dangerous shoals which are a menace to navigation, and which in the event of war would seriously handicap our battleships. If commercial New York, exposed as it is to the guns of a hostile fleet, is just beginning to make discoveries of new formations and obstructions in its waterways, it is high time that the people elsewhere along our coast lines should wake up to the importance of increasing and developing the Coast and Geodetic service.

I have not time to further discuss the work along the Atlantic coast except to say that the Maine waters abound in rocks and shoals. The wire drag service is badly needed there, as it is all along the New England coast. The report of a recent survey in the vicinity of the Rockland Naval Trial Course discovered no less than four shoals, on any one of which a battleship might have been seriously damaged. It is noteworthy also that in a survey of the approaches to Narragansett Bay, one of our most beautiful sheets of water, evidences of hidden formations were discovered. As

late as 1914 the wire drag party found no less than 50 shoals at the entrance to Buzzard Bay, from which vessels now pick their way into the newly constructed Cape Cod Canal.

The United States Corps of Engineers and its Relation to the United States Coast and Geodetic Survey: BRIGADIER GENERAL W. M. BLACK.

The association in work of the corps of engineers and the United States Coast and Geodetic Survey began with the organization of the Coast and Geodetic Survey.

The Corps of Engineers was organized as a separate body in 1802 and of it the U. S. Military Academy formed a part. The first superintendent of the Coast and Geodetic Survey, Ferdinand R. Hassler, was appointed from the corps of instructors of the academy, having served there as acting professor of mathematics from 1807 until 1810.

When the necessity for the better mapping of our coasts was impressed upon President Jefferson he selected Hassler to take charge, though it was not until 1816 that the work of the survey was actually begun. About a year later the work was discontinued, though the survey of the coasts was carried on thereafter by officers of the engineers and of the Navy until the bureau resumed its operations under Hassler in 1832.

Among the engineer officers on duty on survey work prior to 1832 was John J. Abert, who as major and lieutenant colonel, was engaged in many surveys of the coast from 1816 to 1827.

For several years beginning in 1818 the international boundary surveys required under the Treaty of Ghent were carried on along the northern boundaries of New York, Vermont, New Hampshire and Maine. Second Lieutenant Delafield, Captain Partridge and Professor Ellicott of the corps of engineers and Professor Hassler of the Coast Survey were engaged in the work.

When in 1843 it was deemed necessary to reorganize the Coast Survey the corps of engineers again lent its aid. Alexander Dallas Bache, a graduate of the Military Academy of 1825, and during his period of service in the army an officer of the corps of engineers, was appointed superintendent and remained as the head of the survey until his death in 1867.

In announcing his death the Secretary of the Treasury paid tribute to the value of his services in maintaining the high scientific character of the survey.

From 1843 through a period of many years, officers of both the Army and Navy served by detail with the Coast Survey Bureau.

The accurate method of observing latitude with the zenith telescope was the invention of Captain Andrew Talcott of the corps of engineers.

This record shows how directly the corps of engineers has been interested in the work of the Coast and Geodetic Survey.

During the past half century the two services have had few opportunities to associate in the same work, but the association of the two organizations does not end with this. Their work is mutually helpful.

When a harbor is to be improved the first recourse of the army engineer is to the charts of the Coast and Geodetic Survey, by means of which the changes which have occurred are studied and on these studies plans for improvement are afterwards formulated.

The triangulation points established by the Coast and Geodetic Survey are used when available as a basis for the work of the engineers.

Free interchange of information is made between the two organizations and the work of one supplements that of the other.

In a recent examination by the United States engineers of East River, New York, it became necessary to study the tides and tidal currents to determine the probable effect of certain proposed works. A careful study made in former years by Professor Henry Mitchell, of the Coast and Geodetic Survey, furnished much of the information required and checked closely with later observations by the engineers.

In considering plans for the improvement by the United States engineers of the Hudson River, a study of the tides and currents is of the utmost importance. Scientific research of this kind falls within the duties of both the corps of engineers and the Coast and Geodetic Survey.

To the unthinking it might appear that once the coasts had been charted the need of further surveys would cease. Such is not the case. The sea is both a builder and destroyer of shores and her labors are unceasing. Maps require constant and periodic revision.

In yet another way the work of the Coast and Geodetic Survey is useful to and is utilized by the corps of engineers and that is in the preparation of projects for national defense. For this purpose the charts of the Coast and Geodetic Survey are at once available.

The work of the Coast and Geodetic Survey and

that of the United States engineers touch at many points, but their respective spheres of duty are well defined and separate.

The great work done by the Coast and Geodetic Survey in its hundred years of existence and the traditions of faithful labor well performed will always be an inspiration for further effort.

The Lighthouse Service and its Relation to the United States Coast and Geodetic Survey: George R. Putnam.

All progressive maritime countries have recognized their obligation to survey their coasts and to light and mark them. When a country builds a lighthouse or publishes a chart of its coast, it aids the whole family of maritime nations, and such works show an international public spirit.

At the very beginning of our national government an act was passed, approved August 7, 1789, providing for maintaining the lighthouses. There were then but eight lighthouses in operation within the United States. From that small beginning has grown the present Lighthouse Service of this country, the most extensive lighthouse system under a single organization in the world. It maintains 14,544 aids to navigation; it employs 5,792 persons and uses 113 vessels in its work.

Maintaining lights, fog signals, buoys and beacons to guide vessels has required, in order to reach the highest effectiveness, the utilization of available apparatus and the development of new apparatus of a high order. There has been a continuous and a steady advance from the time of the first lighthouse in this country.

An accurate and thorough hydrographic survey of the coast is a necessary preliminary to the intelligent location of lighthouses and buoys and beacons; in fact, without an accurate chart it is always possible that a buoy or beacon may be stationed so as to lead a vessel directly on to some hidden and unknown danger.

The lighthouse work and the coast survey work have an important object in common; the purpose of both is to protect mariners and keep them out of danger, to give the shipmaster all possible help to steer a safe course. One gives him the map showing where the water is safe for his vessel, the other gives him the light, fog-horn and buoy to guide him over this course.

These services cooperate in many ways. The Coast Survey has made special surveys needed in connection with selecting the location for lighthouses, and has determined accurately their locations. The Lighthouse Service promptly marks new dangers located in the course of surveys, such as the wire drag work, and changes the position of buoys and other aids as is shown to be necessary by revised hydrography; it aids the Coast Survey with any information obtained by its vessels. A great amount of work is required in locating the aids correctly on the charts, and in keeping this information correct, and in this work there must be close cooperation between the services. On a single chart, that of New York harbor, there are shown 299 aids to navigation.

As both nature and the works of man are constantly changing the coast line, channels and harbors, and as the course and needs of commerce also are ever varying, it is evident that both the charts and the beacons for the aid of mariners must ever be corrected and modified; therefore the cooperation in these two important works must always be continued as in the past.

Hydrography and Charts, with Special Reference to the Work of the United States Coast and Geodetic Survey: George Washington Littlehales.

A century ago, the states and the people, through their senators and representatives in Congress, authorized the President of the United States "to cause a survey to be taken of the coasts of the United States in which shall be designated the islands and shoals, with the roads or places of anchorage, within twenty leagues of any part of the shores of the United States; and also the respective courses and distances between the principal capes or headlands, together with such other matter as he may deem proper for completing an accurate chart of every part of the coasts within the extent aforesaid."

Congress has shown the strength of intention underlying this enactment by making continuous annual appropriations through the one hundred intervening years and by authorizing as an aid to the prosecution of so important a public task large drafts from the army in earlier years and yet larger ones from the navy as long as they could be spared from the exacting needs of the battle fleet.

How was this justifiable, and how justifiable was it? The results served the life of the nation. No cargo is ever exported or brought home without invoking the protection of this survey; no ship ever enters or leaves our ports without receiving its aid.

In proceeding oceanward from the borders of the continent, along which the triangulation or

mensurational framework of the Coast Survey has been conducted and the topography delineated, the land dips gradually under the sea. It is the province of marine hydrography, by means of measurements of the depth of sea located in position with reference to the triangulation on shore, to discover and to chart the features of this submerged bordering land, thereby indicating the hidden dangers to be avoided by mariners and the channels where safety is to be sought in the guidance of shipping. The mission of the hydrographer has thus been that of a pathfinder to lead the way to our ports and harbors, not only at home, but also in the distant countries over which the jurisdiction of the United States extends; to tell the seafarer of the favoring tide, and by how much his compass declines from the true meridian; and to warn him where his safety is beset.

It must be with no small degree of pride that men should trace their professional lineage to a calling which has prepaid the premium of a policy of insurance upon the seaborne commerce of the United States and made the coast of the United States its best known geographical feature—a calling reaching so far back into the history of our country, so enriched with the heroisms of the sea and with the names of illustrious defenders of the nation, and so unexcelled for the aggregate of its influences in promoting the security of shipping and safeguarding the lives of seamen.

The Contribution of the United States Coast and Geodetic Survey to Geodesy: WILLIAM HENRY BURGER.

To be printed in SCIENCE.

The Civil War Record of the United States Coast and Geodetic Survey, and what the Survey is Doing towards Preparedness: REAR-ADMIRAL RICHARD WAINWRIGHT.

My acquaintance with the U. S. Coast and Geodetic Survey for over sixty years is my warrant for attempting to give the record of the field force of the survey during the Civil War. During my boyhood days I have listened to many talks about the deeds of the field force of the survey and have met many of the assistants who served in the army and navy during the Civil War. Their names would sound familiarly to the old cave-dwellers of this city. They were early volunteers of their services to the country, and their assistance was eagerly sought by generals in the field and admirals afloat. The officers of the survey were in frequent consultation with officers of the army and the navy in regard to operations along the coast, and in nearly all naval and military movements they aided by making reconnaissances and soundings, placing buoys and piloting in interior waters. The field force of the Coast Survey gave valuable military service to their country during the Civil War and afterward they returned to their regular duties, without any of the rewards of rank or pay or pension, for themselves or their families, so freely distributed at this time for military services; but they had the satisfaction that is the reward of all earnest workers of knowing that:

"Duty done,
Is Honor won."

Prior to the Civil War, and again some time after its close, naval officers were detailed to duty with the survey. They had the opportunity of learning to command and to exercise their own initiative. They had to learn to conquer difficulties and to make things do, for in no other government service is more required and smaller means provided for its accomplishment than in the Coast Survey. I am glad to see that the present superintendent is gradually forcing the Coast and Geodetic Survey from its dignified scientific obscurity into the light of the public eye. Congress will not appropriate liberally unless the public is interested.

The constant work of keeping our numerous harbors and channels correctly charted, with the aids to navigation located and the tides computed, is necessary for the commerce of peace, as well as in preparation for war; and there are points where a close survey is of value to the navy, although of little use to commerce.

In time of war the field force of the Coast Survey will be needed as it was during the Civil War. The army and navy are both very short of officers and there is little likelihood of its being otherwise for many years. A trained topographer would always be of value on the staff of a general. In modern war, with long-range guns, the general must visualize his work by close reference to the map and a topographer from the Coast Survey would find little training necessary to keep the new features and movements of the troops plotted ready for the commanding general.

In the navy a skilled hydrographer would prove a most valuable addition to the staff of an admiral. His power of quickly locating his position on a chart would be of assistance in bombardments, blockading, mining and counter-mining.

On the practical side the work of the survey has been well done and with economy. The Coast Survey charts stand at the head of all others for accuracy, execution and general usefulness. The

field force of the Coast Survey has always given loyal service to the country. If war should come they and their distinguished superintendent will be prompt to offer their services. They will be again ready. May they then find the nation more grateful than did those who were detailed from the survey during the Civil War.

The International Work of the United States Coast and Geodetic Survey: Dr. Otto Hilgard Tittmann.

Speaking of the international work of the Coast and Geodetic Survey done in direct cooperation with other countries, Dr. Tittmann said that it may justly give satisfaction to the members of the survey that the results of its work are nearly all international in their scope.

The hydrographic and tidal surveys are obviously for the benefit of all mankind because they safeguard the commercial intercourse of nations. Its geodetic work contributes to the knowledge of the earth's dimensions and constitution. The world's knowledge of terrestrial magnetism would be incomplete without the record of the observation of magnetic phenomena as they occur in the vast territory inhabited by us and so with those relating to the tides. Thus in the prosecution of its tasks, the survey adds to our knowledge of the planet which we inhabit and thereby furthers the ultimate aim of all civilization, the intellectual development of mankind.

He then referred to Senator Sumner's speech delivered immediately after the acquisition of Alaska in which Sumner spoke of the north and south boundary of the territory just acquired as extending to the frozen ocean or the "North Pole if you please." Mr. Tittmann evidently believes that the Senator intended to lay the foundation for a claim to any land which might lie between Alaska and the North Pole. He pointed out that Admiral Peary visited the North Pole end of the line, and that during the famous journey he was formally attached to the Coast and Geodetic Survey for the purpose of observing Arctic tides.

After briefly reviewing the delimitation of the Alaska boundary, extending over a length of about 1,800 miles, by the survey, Dr. Tittmann described the part taken by the survey in the delimitation and remonumenting of our northern and also of the Mexican boundary, undertakings which he considered the most striking of the survey's international accomplishments.

He then spoke of the relation of the Coast Survey to the International Geodetic Association and its supervision of two small astronomical observatories for observing the variations of latitude, maintained in this country by the association. He also described the survey's share in the scientific work leading to the establishment of the International Bureau of Weights and Measures, pointing out that the directorship of this important bureau was offered to the American delegate, Mr. Hilgard, of the Coast and Geodetic Survey, but was declined by him.

International scientific expeditions made by the survey, including transit of Venus expeditions, and those for observing solar eclipses, were rapidly passed in review by the speaker, who, in concluding, expressed the hope that the next centennial celebration of the Coast and Geodetic Survey might afford as satisfactory a retrospect as the present.

Oceanic Tides with Special Reference to the Work of the United States Coast and Geodetic Survey: Dr. Charles Lane Poor.

The mathematical theory of the tides begins by assuming a solid earth surrounded by a shallow, frictionless ocean. In such an ocean the attraction of the moon would cause waves to travel around the earth from east to west. For many years the complete mathematical solution of this simple problem taxed the ability of the ablest scientists, and when finally solved the solution did not materially advance the theories and explanations of the actual tides in the oceans as they exist on the earth.

To pass from this ideal world to actuality; from a simple all-pervading ocean of uniform depth, to oceans separated by continents, and varying in depth, defies the skill of the mathematician. Yet Newton, Laplace and a succession of brilliant mathematicians have all tried to do this; to pass from the simple to the complex. They consider the tides as a world phenomenon—as an ideally simple wave, modified, broken up, and delayed by the continental barriers; by the varying depths of the oceans. Sir George Darwin considers the great earth tides as formed in the broad, deep waters of the southern Pacific. From here the tidal wave spreads east and west, around Cape Horn and past Cape of Good Hope, and sweeps through the Atlantic at a rate depending solely upon the depth of the water.

This simple world idea of the tides was evolved and elaborated from observations of the tides of Europe. In the days of Laplace there was little knowledge of the tides in other parts of the world, and it was naturally thought that the European tides were fairly representative. The dy-

namical, or world wave theory, fitted and explained the simple tides, and thus became the basis of all tidal work and theories. Later the tides in the Pacific and Indian oceans were studied and were found to differ greatly from those of Europe, in fact, the tides of the North Atlantic are exceptional in their simplicity. Yet as each new complication was found, it was explained away, as a modification of the general grand wave, due to some local condition. The theory that the tides are a world phenomenon has the support of the world's greatest mathematicians and all the prestige their names can lend.

Certain investigation of the Coast and Geodetic Survey would indicate that this theory may not be the correct explanation of the oceanic tides. During the century of its existence this body of skillful observers and able investigators has collected and discussed an enormous amount of tidal data in both the Atlantic and the Pacific oceans. As these observations were collected and brought together, discrepancies were found; the tides of one port could not be fitted into and made to harmonize with the tides of another place. A few such discrepancies could be explained as modifications of the general tidal wave, but as observations were increased in number, discrepancies multiplied, and to fit all conditions, the general tidal wave would have to writhe and squirm, and change its form and character from place to place until it lost all semblance of a single uniform progressive wave. Gradually there has been evolved the feeling that the tides are not a world phenomenon, but are strictly local in character and in being; that the tides of the Atlantic Ocean are due to the oscillations in the waters of the Atlantic, independent of what has or may happen in the waters of the Pacific.

This idea of the tides as purely local phenomena, as opposed to the theory of a grand earth-wide wave, has been elaborated and developed by the Coast and Geodetic Survey into a thoroughly consistent theory. And this explanation of the tides stands out as the great scientific contribution of the Coast and Geodetic Survey to the theories of oceanic tides.

The Contribution of the United States Coast and Geodetic Survey to Physical Geography: DR. DOUGLAS WILSON JOHNSON.

Every division of physical geography is indebted to the U. S. Coast and Geodetic Survey for the invaluable contributions which it has made during the past hundred years of its existence.

Considering the general earth relations, we owe to the services of this organization much of our knowledge concerning the size and form of the globe. Among the Coast and Geodetic Survey's contributions along this line are its longitude determinations, international cooperative work in the determination of the variation of latitude, and the gravity and azimuth observations made in connection with extensive triangulation work. Terrestrial magnetism has received a special study along this line, and has added largely to our stock of information on this important phenomenon of the earth.

The physical hydrography of the ocean has been enriched by the detailed study of the form and composition of the bottom through the regular hydrographic operations of the survey and special oceanographic cruises which they have made. Our knowledge of the Gulf Stream and other currents of the ocean and its tributaries comes largely from the researches of the survey. Its work along tidal lines and regarding tidal currents has been truly monumental, and among its many important contributions along this line may be mentioned the exposition of the equilibrium theory of tides, and its development.

In the study of land forms, the detailed charts of coastal features revised by frequent resurveys gives a complete record of the changes in coastal topography, and by throwing considerable light on the laws of wave and current action have proven to be of incalculable value.

Even the physical geography of the atmosphere is indebted to the survey, for Ferrel's meteorological researches and other studies of the winds and related phenomena are among the important contributions of the survey along those lines.

At the banquet, on April 6, in addition to the address of the president of the United States, printed above, the following addresses were made:

The Minister of Switzerland said in part:

It may surprise some of you that the only foreigner who has the privilege to say a few words on this festive occasion is the Swiss minister. Needless to state that there is no foundation whatsoever for the facetious suggestion that profound political reasons governed the choice of the representative of the only country which has no coasts, no harbors and no navy, to assist in this Jubilee Celebration of the United States Coast Survey.

I owe my presence here to the circumstance which is alike honorable and agreeable to me, that the first superintendent of the Coast Survey, which now has grown so great and celebrated, was the Swiss engineer Ferdinand Rudolph Hassler.

At all times in the history of the United States some of my countrymen may be found, who assisted in the development of this country and who have made a place for themselves in the hearts of grateful Americans.

The activities of Professor Hassler, as founder of two of your great national enterprises, that is, of the Coast Survey and the Bureau of Standards, took place in the first half of the nineteenth century. A retrospect shows us, that during those fifty years my countryman had as contemporaries several distinguished Swiss, who emigrated to this country at about the same time. First among them, it gives me particular pleasure to mention Hassler's friend, Albert Gallatin, of Geneva.

Actuated by the same spirit as Lafayette, Gallatin at the age of eighteen crossed the ocean in order to fight for American independence. Later on he achieved the highest honors open to a Swiss in this country. He was not only the first foreign-born Senator of the United States, but for twelve years he served with acknowledged ability and success as Secretary of the Treasury under Jefferson and Madison. He went to England with John Quincy Adams as a peace commissioner and remained abroad until 1823 as Minister to Paris. After his return he declined the offer of the Democratic party to become a candidate for the Vice-presidency, because he wished to devote all his time to his scientific studies of finance, history and ethnology.

Not less well known to you, gentlemen, is the name of the Swiss naturalist, Louis Jean Rudolph Agassiz, of Motier, who during the twenty-seven years of his incumbency made famous the chair of zoology at Harvard. His son, Alexander Agassiz, who was born at Neuchatel in 1833, and who labored in the same field of research at Harvard as his father, was at one time an aid in the Coast Survey, with which he remained closely associated, as shown in his book "Three Cruises of the *Blake*." A very special reason for mentioning his name is that he was so highly esteemed by President Cleveland that the latter offered him the superintendency of the survey, but Agassiz preferred to continue his favorite researches.

The Secretary of the Navy, the Hon. Josephus Daniels, spoke of the cooperation between the Coast and Geodetic Survey and the navy and called particular attention to the fact that for a number of years naval officers were detailed for duty in the survey, where they had charge of the vessels engaged upon the hydrographic work. When the Spanish war began the naval officers returned to the regular naval duties on the fleets. Since that time all of the work of the Coast and Geodetic Survey has been done by civilians.

The Secretary of Commerce, the Hon. William C. Redfield, said in part:

The record of service that we close to-night is one of which any group of men may well be proud. The fine traditions of this service that survive in your hearts I know are dear to you. I know a little of what they have meant to you of personal sacrifice and of struggle under adverse conditions. I know what you have done in the lonely places of the world, unseen and unwatched, untold, with none to advertise. I want it known that we here know and appreciate and honor the men who carry the burden and heat of the day.

The work of surveying and engineering is not spectacular. It is not comfortable to climb a mountain peak with a pack of instruments upon your back. There is nothing that gets readily glorified in being a victim to mosquitoes in Alaska.

There are fine traditions in this survey and there are curious ones. I think it is not generally known that the artist Whistler was a draftsman in the Coast Survey. He is said by his fellow draftsman, who was a grandson of Francis Scott Key, the author of the "Star Spangled Banner," to have made more sketches than he did drawings.

I want to speak to you very briefly of the present and the future of the Coast Survey; what it is, what it has with which to work, what its task is, what it hopes to do.

The work is splendid in its sweep, from the Sulu Sea just north of Borneo to the cold waters of Alaska in the Pacific, and from the tropical waters around Florida to the Canadian coast in the Atlantic, and on all the continental area of the United States between, and all along the backward limits of Alaska.

Dr. T. C. Mendenhall, former superintendent of the Coast and Geodetic Survey, took as his theme the salient features of the careers of the various superintendents of the survey, starting with Hassler. He sketched the development and progress of the survey during its one hundred years of existence and expressed the hope that its work during the next century might compare in character with that of the first.

FRATERNITAS MEDICORUM; A REPORT AND A DISCUSSION

IN the issue of SCIENCE for August 6, 1915, an "Appeal to the Men and Women Engaged in Medical Practise and the Advancement of Medical Sciences" was published, asking them to join the organization of the Medical Brotherhood for the Furtherance of International Morality. It was signed by about 150 members of high standing in the profession of this country, many of whom enjoy an international reputation. Soon after its publication, we began sending out the appeal and an enrollment card to members of the medical profession. We wish now to give an account of the results thus far attained, and to discuss the nature of this venture and its merits.

Report.—To this date about 14,000 American physicians have enrolled as members of the Medical Brotherhood, the greatest part of whom are either members of medical societies of good standing or of societies which cultivate medical sciences. The appeal was also sent to some of the leading members of the profession of other neutral countries. Here again we obtained very encouraging results. We received, and continue to receive, requests from members of the medical profession of these countries to be enrolled as members of the Brotherhood of our country. Among our correspondents are such well-known men as Theodor Kocher, Einthoven, Thalma, Rovsing, Thunberg, Von Monakow, Zwaardemaker, de-Quervain, Jacquet, Marsden and others of similar high standing. The appeal was published in some of the medical and scientific journals of these countries, and we have the encouraging information that organizations similar to ours were started there. Quite recently the Nederlandsche Vereeniging voor Heelkunde (Holland) requested to be enrolled as a member of the Medical Brotherhood of this country. *We did not approach members of the profession in any of the belligerent countries;* nevertheless, we received requests to be enrolled from medical men in Finland (Russia) who probably read the appeal in Swedish medical journals.

The 14,000 members of the medical profession of this country who have enrolled as members of the Brotherhood represent about 15 per cent. of the number of physicians to whom the appeal was sent. We have, therefore, good reasons to consider henceforth the Fraternitas Medicorum as an established organization.

Analysis of Objections.—While it is idle to speculate as to the real attitude of those who did not respond to the appeal, certain instructive facts, capable of shedding light upon this question, may, nevertheless, be learned from an analysis of part of the correspondence we have had. We shall not include in the discussion the numerous letters in which the writers unreservedly and enthusiastically approve our movement. But we have to mention that among the enrolled members are some who originally looked upon the enterprise with misgivings. We shall mention further the instructive fact that a number of physicians asked for enrollment cards months after the appeal was sent to them, stating frankly that they threw away the appeal without even having read it, because they were bothered with too many war and peace circulars.

However, we received about 27 letters, the contents of which were unmistakably adverse to our movement. Nine of these communications were anonymous; they contained offensive remarks, assuming that the Medical Brotherhood was a part of an organized German propaganda, that the expenses were met by the German Kaiser.

Among those who signed the adverse letters are several from men who are of high standing in the profession and are personally known to us. Several of our correspondents, some of whom were during the present war for short periods in France, stated that there is not a neutral fiber in them.

Two correspondents objected to the idea that physicians have a higher claim to international morality than other people. Several of our correspondents said that they either could not see the object of the movement or, as one expressed it, he could not see where "the uplift comes in"; or, on the contrary, that the aim of the Brotherhood is too Utopian for them. Finally, several writers approved the idea in general, but thought that the organi-

zation of a Medical Brotherhood should be postponed until after the war.

The objections to the organization of the Medical Brotherhood, as far as could be ascertained from this small number of adverse manifestations, may be summarized as follows: (1) That it is a part of a German propaganda, or, at least (2) a veiled pro-German movement; that (3) it is meant to be a neutral body which, therefore, ought not to be supported because the paramount duty of American physicians ought to be to assist the Allies; that (4) physicians have no higher claim than other people to international morality; that (5) there is no object (no uplift) in this organization; that (6), on the contrary, the object is too Utopian and finally, (7) that the movement is premature.

Financial Resources.—Small as the number of our critics is, their adverse points of view merit public discussion. In so doing we shall deal in the first place with the most objectionable interpretation given to the aims of the Medical Brotherhood, namely, that it is a part of a pro-Teutonic propaganda and that it is financially supported by the German government. In the appeal, as well as in a letter published in the *Journal of the American Medical Association* (Vol. 65, p. 971), it was expressly stated that the Brotherhood is neither a pro-Teutonic nor a pro-Allies movement. Such assurances probably do not reach the type of men who are capable of writing anonymous letters. But we owe it to the medical profession at large to make the following statement regarding the financial resources of the Medical Brotherhood, which is as follows: Private contributions, to the amount of $630.00 were made, in smaller and larger sums, by some of the enrolled members. The main financial support comes, however, from the Carnegie Endowment for International Peace. The executive committee of this body granted us a liberal fund for the purpose of developing our organization. The executive committee is made up of such men as President Butler, President Pritchett, Elihu Root and others of similar high standing. It is quite safe to say that no individual with normal judgment could think for a moment that these foremost American citizens would consent to support a pro-Teutonic organization. But ought such a question have been raised at all by any fair-minded member of the profession in the face of the standing of the members of the committee which signed the appeal? Would, for instance, the surgeon generals of the Army, of the Navy, and of the Public Health Service have consented to be honorary presidents, if the Medical Brotherhood had any ulterior, pro-Teutonic or other un-American, tendencies?

General Discussion.—As to the other criticisms, they can be best met, we believe, by discussing the fundamental considerations underlying this movement. The term "brotherhood," it is true, recalls to mind a state in which all men shall treat one another like brothers—like good brothers. This is an ideal which may never be attained. The specter of the unattainable drives practical men away from such ideals. But it should be remembered that the ideal is of great educational value, if utilized merely to indicate the *direction* which our practical activities ought to take. However, the Medical Brotherhood directs its appeal only to the medical fraternity and does not intend to deal with unattainable objects. The medical profession has a training which is scientific in character and method, and which has, in modern times, among its precepts the following maxims: (1) That the development of a new view must be started on the basis of an assured fact and not from mere desire or by the impulse of an untamed phantasy. (2) That one need not be afraid to assume, or to work for, something which has not received the approval of that great authority, the practically wise man. (3) That one should not work for the demonstration of the correctness of the new assumption, or for the realization of the new aim, in the manner of the practical man, that is, by violent activities and in the expectation of attaining completely the desired end in a month or a year (perhaps to lose it in a shorter time), but, on the contrary, must work patiently, trying to attain the end, or even only small parts of it, by

steps which may appear to be very small but which offer the greatest chance for permanency. (4) That one is not to be discouraged by some failures. And, finally (5) that one is to care more for progress in the right direction, than for attainment of the goal.

Now the development of our organization was started on the basis of the following indisputable facts. The ethical relations between separate nations are far behind the state of morals governing the relations of individuals of the same nation. International morality progresses at best in waves, positive and negative, making perhaps three steps forward and two and sometimes four or five steps backward. However, during the normal state of the world's affairs, ethical men of all countries are ready to be guided by the two great moral principles: patriotism and humanity. The present world-wide catastrophe demonstrated, however, that even the most idealistic citizen is often incapable, and, in fact, is usually not in a position, to serve both ethical principles at the same time, while his country, right or wrong, is at war with another country. Physicians, however, are in an exceptional position; they are permitted and even required to observe both ethical demands even during war. In war the physician's services to his country are as necessary, as great, as that of the warrior, but he is in the fortunate position of being able to treat his compatriot and his country's foe alike. That standard of morality is upheld not only by the medical profession itself, but is practically demanded by the regulations agreed upon by the various international conventions, regulations which have been rarely broken even in the present most brutal war. Even in the present state of frightful confusion of judgment, practically no sane individual exists who would not consider this standard of morality desirable to obtain in all domains of human endeavor—if it were attainable. These are safe facts. Now the Medical Brotherhood was organized primarily to bring these instructive facts to the consciousness of the members of the medical profession, to tell them of their ethically privileged status. This message is not sent to non-medical men; neither do we mean to say to the non-medical man: we physicians are holier than thou. We wish only to convey to physicians the message that their profession permits them to remain at all times simultaneously patriotic and humane, and that they should train their character properly so that they could be fit to exercise this high privilege. The nearest and simplest end to be gained from such information is the consciousness of a sense of higher duties which comes from the knowledge of one's higher moral dignity.

There is no doubt that the medical profession is a noble calling. Do medical men represent a noble class? They ought to. There are two good reasons for such an expectation. "A medical man whose ethical standard is not above that of the average man is morally below him." His activities are of a most serious nature; they concern life; and, furthermore, they can not, as in other callings, be controlled by anybody or anything else but the physician's own conscience; that conscience therefore must be of a higher type. Then the physician has constantly to deal with suffering, that of the patient and of those to whom the patient is dear; sympathy, therefore, ought to be an integral part of the make-up of the desirable physician. It is true that the medical calling is at the same time the physician's business by which he makes his livelihood; it is therefore often afflicted with many of the moral shortcomings which frequently go with money-making occupations. The Medical Brotherhood, however, does not deal and does not have to deal with this side of the physician's life. It deals with the physician in his relation to his country, when he acts and has to act as a patriot; or when other countries are at war with one another, when the physician of neutral countries has to act as a humanitarian. Here every physician can afford to exercise his noble profession in a noble spirit. It is that for which the Medical Brotherhood appeals to all physicians of our country. That alone seems to us to be an object worth while working for.

The fact that within only about nine months

and without agitation and publicity about 14,000 members of the medical profession of the United States alone should have joined the Medical Brotherhood shows that we struck the right chord. This group of medical men and women, the vast majority of whom surely have more or less idealism, represents about 10 per cent. of the medical profession of this country. Moreover, there can be no doubt that the appeal issued by the committee exerted a morally favorable influence upon many members of the profession who did not formally join the Medical Brotherhood; and there is great probability that a good many will join it, when the war approaches its end.

In this connection we may call attention to the most encouraging fact that the medical journals of our country act in a most exemplary manner with relation to the war. None of the journals, at least none known to us, has indulged in offensive discussions of the various belligerent nations or made disparaging comments on the behavior of the medical members of these nations. The subject of the present war has been handled by the medical journals with rare good sense and tact. In a general way, the same may be claimed for the utterance of the members of the medical profession when made in lay gatherings or publications, although here the unavoidable small fraction of exceptions has not been lacking. The Medical Brotherhood has had occasion to remonstrate in two instances: in one with complete and in the other with partial success.

From the point of view of the scientific investigator, who is not afraid of Utopian ideals which may give him the direction for his work, but who works for his goal by small and practicable steps, we may claim for the movement of the Medical Brotherhood that it has a definite object, "an uplift," that it is not Utopian in its direction, that it was undertaken at the right time—when the medical mind was in a state of fermentation—*in statu nascenti*, and, best of all, that the movement has already attained a gratifying success: it has aroused the moral, humane spirit in a great many members of the profession in this country as well as in other neutral countries.

We have no quarrel with those of our colleagues who do not wish to join the Brotherhood, because, as they say, they can not be neutral in this war. No matter with which party one sides, and what his wishes may be, we do not question the moral nature of his motives. But we wish to make the following remarks: First, the Medical Brotherhood does not aim for mere neutrality. Neutrality is neither impartiality nor humanity. A neutral occupies, with reference to war, the same moral level as the belligerents, with the mere difference that he is not in it, or not yet in it. The Medical Brotherhood wishes to occupy a position above this level. War represents a very backward place in the development of human ethics. The various belligerent nations are simply products of the same moral phase, the same development period. The medical profession is fortunate to be able to occupy an advanced ethical position. Its members should be aware of it and should adhere to it. Secondly, the Medical Brotherhood is, from practical considerations, concerned only with the medical part of its members. As private individuals the members are at liberty to sympathize chiefly or exclusively with one side or the other of the warring parties. What we expect of members of the Medical Brotherhood is that they should commit no public act which is not in harmony with the advanced moral standing of the medical profession. One who does not feel that he can bind himself to this simple obligation, or one who does not believe, or does not want to assume, that the medical profession occupies an advanced moral position, should, of course, not join the Medical Brotherhood. This organization must consist of medical men and women who believe in the advanced ethical position of the medical profession and are willing to live up to this belief. It is as certain as day that only good and no harm can come from such a belief.

We shall not risk presentation of a list of problems which we may be called upon to try to solve now or later; "each bridge will be

crossed when we get to it." One thing we may state definitely: we do not intend to meddle with problems which deal with the terminating of the present war. The exertion of our energies will be limited to that which is attainable to us. On the other hand, we contemplate dealing definitely with this one problem: at the termination of the war, or even at the mere sight of this termination, an attempt should be made to unite the medical men of all the neutral countries for the purpose of arranging an early international meeting of the medical profession, to which meeting some members of the profession of the belligerent countries, who are or may then be in harmony with our ideals may be invited. We shall thus perhaps be in a position to accelerate an early *rapprochment* and fraternal reconciliation of the members of the medical profession of all the civilized nations. Here again we shall attempt to do our duty as we see it, without being too sanguine as to an early and complete success.

Hippocratic Oath.—A few of our sympathizing correspondents wished to know whether the aims of the Medical Brotherhood are not already covered by the Hippocratic oath. No; that oath covers only the relations of the physician to the individual as his private patient or pupil. As we all know, the influence of this oath leaves plenty of room for the ethical activities of the American Medical Association, the newly created College of Surgeons, etc. The Medical Brotherhood does not intend to deal with any part of this phase of medical affairs; it has in view exclusively the relations of the physician to his country as a patriot and to other countries as a humanitarian.

Patriotism and Medical Preparedness.—We have stated that medical men are in a position to be patriots and humanitarians at the same time. We have so far dealt exclusively with the international side of the Brotherhood. In fact, in the appeal it was expressly stated "For the Furtherance of International Morality." However, it would not be out of place to add a few remarks regarding patriotism and the relation of the physician to it. The present war, while presenting a frightful picture of the bloody struggle between the nations, has revealed, on the other hand, a most remarkable ethical side of the relations of the individual to the state in each and every one of the belligerent countries. The readiness of the individual to be helpful to, and sacrifice himself for, the state stands out as a shining light in the midst of the extreme darkness of the war. But here we wish to speak especially of the relations of our own physicians to our own country. Preparedness is a subject which at present agitates profoundly the minds of all of our citizens. It is none of our concern here to discuss this subject from the general point of view as citizens. As physicians, however, there can not be the slightest doubt that it is the duty of every member of the profession, who is in a position to do so, to offer his assistance to the medical department of the military organization of our country. We do not know when the country will be called upon to defend itself. It may come suddenly, like a bolt from the skies, which are surely not clear at the present time. Physicians who are not devoid of a sense of duty, should, therefore, prepare themselves with the necessary knowledge and skill, and should in large numbers inform the military medical department of their willingness to serve in case of need. The hygienist, bacteriologist and internist, etc., can be of just as much service as the surgeon in the incidents of war. The medical man who marches with the scouts ahead of the army to select camps, to test the drinking water, etc., is as important as those who work behind the lines. And the medical man whose daily work brings him in contact with infectious and contagious diseases is trained in courage as high as the veteran of many battles; bacteria are as deadly as bullets, and in his daily work the physician, like the man in the firing line, never knows when they may strike him.

On the other hand, the practitioner knows now quite well what importance is to be attached to sympathetic psychical treatment of patients who are in need of it. A training to preserve humaneness in the midst of passion and hatred ought to be a part of medical pre-

paredness. After furious battles the poor injured prisoner of war needs often this mode of treatment as much as the surgical one.

The Medical Brotherhood of this country wishes to gather into its union those members of the medical profession who have a vein of idealism in them and who are willing to serve their country as patriots and humanitarians. It appeals further to the inspired ones to spread this gospel, wherever they find opportunity, with impressiveness combined with patience and tolerance.

S. J. Meltzer,
President of the Medical Brotherhood

GRANTS FOR SCIENTIFIC RESEARCH

During the past year, the sub-committee on research funds of the Committee of One Hundred of the American Association for the Advancement of Science has endeavored to secure information regarding research funds and particularly such as are available without substantial limitations as to the residence or institutional relations of the grantee.

The following list of endowments of the latter class, while doubtless incomplete, is believed to comprehend the more important with the exception of those devoted to medical research. From most of them grants of moderate sums for research may be made to suitable applicants. The list is arranged alphabetically according to location.

Unless otherwise stated the figures given refer to the principal of the endowment. The amounts are to be considered as approximate only.

For information regarding the conditions upon which grants may be made from any particular fund, application should be addressed to the officer indicated in the list.

The present article constitutes a portion of a report made at the Columbus meeting of the American Association. Other portions will be published later.

American Academy of Arts and Sciences, Boston, Mass.

Rumford Fund. $66,300. For Rumford Premium and investigations in light and heat carried on in America. Charles R. Cross, Chairman, 28 Newbury St., Boston, Mass.

Cyrus M. Warren Fund. $12,500. For chemical research. Henry P. Talbot, Chairman, 28 Newbury St., Boston, Mass.

Elizabeth Thompson Science Fund, Boston, Mass. $26,000. "For the advancement and prosecution of scientific research in its broadest sense" without limitation as to country. Walter B. Cannon, Secretary, Harvard Medical School, Boston, Mass.

Harvard College Observatory, Cambridge, Mass. Advancement of Astronomical Science Funds; 1901, 1902. $40,000. For aiding work of astronomers in any part of the world. Edward C. Pickering, Director, Harvard College Observatory, Cambridge, Mass.

Davenport Academy of Sciences, Davenport, Iowa. Mary L. D. Putnam Fund. $23,000. A certain portion applicable to research. Edward K. Putnam, Acting Director, Davenport, Iowa.

Ohio Academy of Sciences, Delaware, Ohio. Annual gift. $250. Applied to research. Edward L. Rice, Secretary, Delaware, Ohio.

Engineering Foundation Board, New York City, N. Y. Ambrose Swasey Fund. $200,000. Regulations regarding use not yet formulated. F. R. Hutton, Secretary, 29 W. 39th St., New York, N. Y.

Sarah Berliner Fellowship for Women, New York City, N. Y. $1,000 annually. For study and research in physics, chemistry and biology. Mrs. Christine Ladd Franklin, Chairman, 527 W. 110th St., New York, N. Y.

New York Academy of Sciences, New York City, N. Y.

John Strong Newberry Fund. $1,000.

Audubon Fund. $2,500.

Esther Hermann Fund. $10,000.

For investigation in natural sciences. Michael Idvorsky Pupin, President, Columbia University, New York, N. Y.

California Academy of Sciences, San Francisco, Calif. Endowments yielding upwards of $65,000 annually, used in considerable part for research. Barton W. Evermann, Director, San Francisco, Calif.

American Association for the Advancement of Science, Washington, D. C.

General Research Fund. About $25,000. For investigation in any department of science. L. O. Howard, Secretary, Smithsonian Institution, Washington, D. C.

Colburn Fund. About $75,000. For "original research in the physical or psychic demonstrable sciences." Regulations regarding use

not yet formulated. L. O. Howard, Secretary, Smithsonian Institution, Washington, D. C.

National Academy of Sciences, Washington, D. C.

Bache Fund. $56,000. For research in physical and natural science. Edwin B. Frost, Chairman, Yerkes Observatory, Williams Bay, Wis.

Watson Fund. $25,000. For Watson Medal and astronomical research. Edward C. Pickering, Chairman, Harvard College Observatory, Cambridge, Mass.

Henry Draper Fund. $10,000. For Draper Medal and researches in astronomical physics. George E. Hale, Chairman, Mt. Wilson Solar Observatory, Pasadena, Calif.

J. Lawrence Smith Fund. $10,000. For J. Lawrence Smith Medal and the investigation of meteoric bodies. Edward W. Morley, Chairman, West Hartford, Conn.

Benjamin Apthorp Gould Fund. $20,000. For researches in astronomy. Forest R. Moulton, Chairman, University of Chicago, Chicago, Ill.

Wolcott Gibbs Fund. $5,500. For chemical research. Charles L. Jackson, Chairman. Harvard University, Cambridge, Mass.

Comstock Fund. $11,300. For researches in electricity, magnetism and radiant energy. Edward L. Nichols, Chairman, Cornell University, Ithaca, N. Y.

Murray Fund. $6,000. For Agassiz Medal and contributions to oceanography. Arnold Hague, Chairman, National Academy of Sciences, Washington, D. C.

Marsh Fund. $9,400. For research in natural science. Arthur L. Day, Secretary, National Academy of Sciences, Washington, D. C.

Carnegie Institution, Washington, D. C. Endowment Fund. $22,000,000. "To encourage in the broadest and most liberal manner, investigation, research and discovery, and the application of knowledge to the improvement of mankind." Robert S. Woodward, President, Washington, D. C.

Smithsonian Institution, Washington, D. C. Hodgkins Fund. $250,000. For investigations concerning atmospheric air. Charles D. Walcott, Secretary, Washington, D. C.

Washington Academy of Sciences, Washington, D. C. Fund of $5,000. Available in part for research. George K. Burgess, Secretary, Washington, D. C.

Archeological Institute of America, Washington, D. C. Fund of $25,000. For excavations in Mediterranean lands. Mitchell Carroll, Secretary, Washington, D. C.

National Geographic Society, Washington, D. C. Research Fund. $35,000. For exploration and geographical research. Gilbert A. Grosvenor, Secretary, Washington, D. C.

CHARLES R. CROSS,
Chairman

THE NEW YORK MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A MEETING of the members of the American Association for the Advancement of Science, residing in or near New York, was held at the American Museum of Natural History on Friday, May 5, at 5 P.M., to discuss plans for the New York meeting of the association in December. About fifty members were in attendance. Mr. Henry Fairfield Osborn was elected chairman and Mr. Henry E. Crampton secretary of the meeting.

The chairman called attention to the special interest of the forthcoming gathering as it involved an unusual number of scientific societies which were affiliated with the association. Called upon by the chairman to outline the present plans for the Convocation Week meetings, Mr. J. McK. Cattell stated that the committee on policy of the council had placed arrangements in the hands of an executive committee consisting of Messrs. Charles Baskerville, Nathaniel L. Britton, J. McKeen Cattell, Simon Flexner, Henry Fairfield Osborn, Michael I. Pupin, John J. Stevenson and Edmund B. Wilson. Certain details as yet unsettled were then presented for discussion by those in attendance, who represented the 1,350 local members of the association.

The cooperation of various institutions and scientific societies was tendered by Henry Fairfield Osborn, George F. Huntington, Alexander Smith, N. L. Britton, R. A. Wetzel, Charles L. Bristol, President Marsh, C. Stuart Gager and Professor Margaret B. Wilson. After discussion, it was *voted* that the executive committee be requested to consider the advisability of the appointment by the local

scientific societies and institutions of representative cooperating committees, and, if possible, to arrange for the establishment of such committees.

It was further *voted* that the executive committee invite each local member to contribute the sum of $5 toward the general expenses of the Convocation Week meetings. It was *voted* to recommend to the executive committee that Columbia University be the general headquarters of the meetings. The action of the executive committee appointing Mr. J. McKeen Cattell as local secretary was confirmed by vote. Finally it was *voted* to recommend to the executive committee that a reception committee be formed, to consist of both men and women, for the arrangement of such social activities as may be deemed desirable.

The meeting adjourned at 6.15 P.M.

Henry E. Crampton,
Acting Secretary

SCIENTIFIC NOTES AND NEWS

The Royal Society has elected as foreign members: Prince Boris Galitzin, head of the Russian Meteorological Service; Dr. C. L. A. Laveran, of Paris, discoverer of the malarial parasite; Dr. Johan Hjort, director of Norwegian Fisheries; Professor Jules Bordet, the bacteriologist of the University of Brussels, and Professor H. Kamerlingh-Onnes, professor of physics at Leyden.

Although obituary notices of Ivan P. Pawlow, the distinguished Russian physiologist, have been printed in the *Journal* of the American Medical Association, *The Lancet*, *Das Umschau* and other journals, it was noted in Science that there may have been confusion with E. W. Pawlow, court surgeon, who died in St. Petersburg on February 11. The Russian Embassy confirms the death of E. W. Pawlow, but can give no information concerning Ivan P. Pawlow. Dr. Francis G. Benedict now writes us that a letter from Madam Pawlow to Mrs. Benedict, received on May 4, and postmarked March 28, states that her husband had not been quite well through the winter. There is thus good reason to believe that the report of his death is incorrect.

Professor W. S. Thayer, of the Johns Hopkins University, gave the presidential address before the Congress of American Physicians at Washington, on May 9, his subject being "Teaching and Practise." We hope to have the privilege of printing this address in the next issue of Science.

The trustees of the Johns Hopkins University announce that the ninth course of lectures on the Herter Foundation will be given by Dr. Theobald Smith, director of the department of animal pathology, the Rockefeller Institute for Medical Research, on May 11, 12 and 15. The subject is "The Relation of Infectious and Immunizing Processes to the General Phenomenon of Parasitism."

Sir Almroth Wright, London, has been elected a foreign associate of the Paris Académie de Médecine.

Dr. Giuseppe Sergi, professor of anthropology in the University of Rome, has completed his seventy-fifth year. In honor of the occasion the Roman Anthropological Society has decided to publish a volume of memoirs.

At the annual meeting of the Iron and Steel Institute, on May 4, the Bessemer gold medal for 1916 was presented to Mr. F. W. Harbord.

The Howard Taylor Ricketts prize for research work done by students in the departments of pathology and bacteriology of the University of Chicago, which is awarded each year on May 3, the anniversary of Dr. Ricketts's death from typhus fever, has this year been awarded to Oscar J. Elsesser.

The Walker prize of the Royal College of Surgeons (£100) has been awarded to Mr. W. S. Handley, of the Middlesex Hospital Cancer Research Laboratory, for his work on cancer.

At the annual meeting of the Marine Biological Association of the United Kingdom in the rooms of the Royal Society on April 12, Sir E. Ray Lankester was reelected president, and Dr. A. E. Shipley, chairman of council.

Captain E. F. Dickins, former head of the New York office of the United States Coast and Geodetic Survey, has been placed in charge of the San Francisco office as the successor of Captain Ferdinand Westdahl.

A LEAVE of absence for the second half of the academic year 1916–17 has been granted by Harvard University to Professor Theodore W. Richards, director of the Wolcott Gibbs Memorial Laboratory.

ASSISTANT PROFESSOR NORMAN MACLEOD HARRIS, of the department of hygiene and bacteriology at the University of Chicago, has been granted a year's leave of absence, beginning with the autumn quarter, in order that he may give his professional services to the Canadian contingent in the European war.

DR. FRANK M. CHAPMAN, curator of ornithology at the American Museum of Natural History, proposes to make explorations in the Andes during the present summer. The expedition is part of a plan to secure several new habitat groups of birds in South America, including the condor and the rhea. Mr. George K. Cherrie and Mr. L. E. Miller will accompany Dr. Chapman.

A SERIES of five lectures has recently been given on the Hitchcock Foundation at the University of California by Professor Thomas Hunt Morgan, professor of experimental zoology in Columbia University. The topics of the lectures were as follows:

April 12. "A Revelation of the Evidence on which the Theory of Evolution was based."

April 14. "The Bearing of Mendel's Discovery on the Origin of Hereditary Characters shown by Wild Species."

April 17. "The Factorial Hypothesis of Heredity and the Composition of the Germ Plasm."

April 19. "Sex Factors and the Mechanism of Sex Determination."

April 21. "Is Selection a Creative Process?"

AT a meeting of the California Chapter of Sigma Xi on April 19, Professor F. P. Gay, of the department of pathology, University of California, as the retiring president, presented an address upon "Specialization and Research in Science." Officers for the ensuing academic year were elected as follows: *President,* C. L. Cory, dean of the College of Mechanics; *Vice-president,* G. N. Lewis, professor of physical chemistry; *Recording Secretary,* T. B. Burnett, assistant professor of physiology; *Corresponding Secretary,* Edmund O'Neil, professor of inorganic chemistry; *Treasurer,* A. C. Alvarez, assistant professor of civil engineering.

DURING the exercises in connection with the Shakespeare Tercentenary Commemoration at the University of Texas, April 22–26, Professor William E. Ritter, director of Scripps Institution for Biological Research at La Jolla, California, delivered an address commemorative of Harvey's demonstration of the circulation of the blood in 1616. The subject of the address was "'Know Thyself'—Interpreted by Socrates, Shakespeare, Harvey and Men of To-day." On the evening of the twenty-seventh, at the annual banquet of the Texas Chapter of Sigma Xi, Dr. Ritter read a paper entitled, "Are we obliged to assume that Spontaneous Generation ever occurred?

ON March 21, Dr. Shepherd Ivory Franz, of Washington, D.C., addressed the students of Swarthmore College on "The Psychology of Delusions" and on March 28, Professor Warner Brown, of the University of California, on "The Psychology of Advertising."

DR. JOHN W. HARSHBERGER, professor of botany in the University of Pennsylvania, conducted an illustrated science conference on "Field Research in Plant Geography and Ecology" on Saturday evening, April 22, at the Brooklyn Institute.

PROFESSOR E. S. MOORE, of the Pennsylvania State College, lectured before the Mining and Geological Society of Lehigh University on April 13, and before the students of the department of geology at Cornell University on April 26 on "Some of the Mining Fields of Australia and India."

AT the annual meeting of the Alabama Society of Mental Hygiene held in Birmingham, on April 8, Dr. Thomas W. Salmon, New York, medical director of the National Committee on Mental Hygiene, delivered an address to the society on "Feeblemindedness."

MR. J. S. DILLER, of the Geological Survey, and Dr. Arthur L. Day, of the Carnegie Geophysical Laboratory, addressed the Geological Society of Washington, on April 12 on "Lassen Peak, California."

Nature states that the applications received for admission to Miss E. A. Browne's lecture on "Our Tropical Industries," at the Imperial Institute, London, on Wednesdays, have been so numerous that no further tickets for Wednesdays can be issued. It has, however, been decided to repeat the lectures on Thursdays in April, May and June, at 3 o'clock, commencing on April 27, and tickets for Thursdays may now be obtained at the Imperial Institute.

Under the auspices of the Geographical Society of Philadelphia, the annual Heilprin Memorial Lecture was given in the auditorium of the University of Pennsylvania Museum on Wednesday evening, April 19, by Professor Lawrence Martin, of the University of Wisconsin. His subject was: "The Gorge of the Upper Mississippi as a Rival of the Rhine Gorge."

The Le Conte Memorial Fellowship endowed by the alumni of the University of California in memory of John and Joseph Le Conte has been awarded for 1916–17 to John Hezekiah Levy, for graduate work at Columbia University in international law.

"Toland Amphitheater" has been selected as the name of the amphitheater in the new University of California Hospital in San Francisco, in honor of Dr. Hugo H. Toland, the founder and long a member of the faculty of Toland College of Medicine, which eventually grew into the present University of California Medical School.

Lucien Ira Blake, A.B. (Amherst, '77), Ph.D. (Berlin, '84), professor of physics and electrical engineering at the University of Kansas from 1887 to 1905 and later chief engineer of the Submarine Signal Co., died in Boston, on May 4, aged sixty-one years.

Sir Colin Campbell Scott-Moncrieff, distinguished as a soldier, as an engineer, and as an administrator, died on April 6, at the age of seventy-nine years.

Mr. J. H. Collins, an authority on geology and mining in Cornwall, died on April 12, at the age of seventy-five years.

The death of Octave Lignier, professor of botany at the University of Caen, celebrated for his contributions to paleobotany, occurred on March 19.

The first number of *Physiological Abstracts* has been issued under the sponsorship of the Physiological Society of Great Britain and Ireland, with the cooperation of the American Physiological Society, and other American, British and continental scientific bodies.

The first number of a bimonthly journal entitled *Revista de Matematicas* has appeared at Buenos Aires under the editorship of Manuel Guitarte.

The *Journal* of the American Medical Association states that the Army Medical Museum possesses a valuable collection of medals relating to medicine which was started and fostered by the late Dr. John S. Billings, and it is highly desirable that this collection should be added to and completed, so far as possible. The assistance and advice of physicians who are collectors of medical medals is respectfully solicited. The museum appropriations will avail to purchase individual medals which are not in the collection, the purchase of private collections, or of individual items in them, will be carefully considered, and private donations of separate medals or groups of medals will be most welcome and will be duly credited to the donors, and the transmission of catalogue of medals for sale is requested.

The contract between the Ohio State Board of Administration and the Otho Sprague Memorial Institute for the establishment of a laboratory at the Chicago State Hospital for research work in dementia praecox has been signed, and the opening of the laboratory now awaits only the selection of a director. The medical director of the Sprague Memorial Laboratory is Dr. H. Gideon Wells of the University of Chicago.

Dr. W. A. Murrill, assistant director of the New York Botanical Garden, writes that there has just come to his notice, through Mrs. Rufus Hatch, of Pelham Manor, New York, a very serious case of mushroom poisoning in which the poisonous specimens were taken from mushroom beds and were supposed to be a new edible variety. The common mush-

room had been cultivated successfully in these beds for two years. Five persons ate the supposed new variety and enjoyed its flavor but were almost immediately stricken with paralysis, their lives being saved only by the prompt action of their family physician. This indicates that it is very unwise to eat or sell any mushroom appearing in mushroom beds except the ordinary cultivated variety with white cap and pink gills. A description of this new poisonous mushroom has been prepared for immediate publication in *Mycologia*.

THE twenty-fifth session of the Marine Biological Laboratory of Stanford University at Pacific Grove, Cal., will begin on May 22, and continue six weeks. Courses will be offered in general zoology and embryology. Provision will also be made for students who are prepared to undertake advanced work in zoology. To investigators who are engaged in research, the use of the laboratory is offered free of charge. The laboratory will be under the general supervision of Associate Professor J. O. Snyder. Further information may be obtained from Mr. Snyder, or from the directors, Charles H. Gilbert, professor of zoology, or Oliver P. Jenkins, professor of physiology, Stanford University, Cal.

THE German Congress for Internal Medicine in Warsaw was planned for May 1 and 2. Last year a similar congress for surgery was held in Brussels. At this congress the diseases which are of particular importance at this time, especially typhoid, typhus, cholera, diarrhea, diseases of the heart and nephritis, will be discussed.

UNIVERSITY AND EDUCATIONAL NEWS

THE contest of the will of the late Amos E. Eno is now on trial in a New York court. If the will is sustained Columbia University will receive over $7,000,000.

HARVARD UNIVERSITY has received $10,699 from the estate of Miss Rebecca W. Brown, to be added to the fund created by her brother, Buckminster Brown, for the foundation of a professorship of orthopedic surgery.

PROFESSOR CHARLES H. RICHARDSON, of Syracuse University, has given to the department of mineralogy his private collection of minerals and rocks, which is valued at $5,000. The collection is being relabeled and placed on exhibition in new cases in the natural history building. The collection will bear the name of the donor.

NEW YORK UNIVERSITY will require two years of college preparation as a condition of entrance into the medical college beginning in 1918.

THE degree of bachelor of arts will hereafter be awarded to students of Columbia College, whether or not they have studied Latin, the degree of bachelor of science being abolished.

DR. DAVID STARR JORDAN, chancellor of Stanford University, has retired with the title of chancellor emeritus.

THE council of New York University has appointed Dr. Samuel A. Brown to be dean of the medical department of the university.

THE summer session of the University of California, which last year enrolled 5,388 students, for its session this year, from June 26 to August 5, will include among the visiting members of its faculty B. M. Allen, professor of zoology, University of Kansas; E. R. Clark, professor of anatomy in the University of Missouri; Moses Gomberg, professor of organic chemistry, University of Michigan; D. S. Hill, director of the Bureau of Educational Research, New Orleans, and E. J. Wilczynski, professor of mathematics, Chicago.

IN the department of natural science of the Michigan State Normal College at Ypsilanti, Dr. Bertram G. Smith has been promoted from assistant professor to associate professor of zoology.

DR. ERNEST G. MARTIN, of Harvard University, will succeed Professor Oliver P. Jenkins, as head of the physiological department of Stanford University.

DR. ROBERT M. OGDEN, professor of psychology in the University of Kansas, has been elected head of the department of education in Cornell University and will take up his work

there at the beginning of the next academic year. Dr. William S. Foster, now instructor in psychology in Cornell University, has been made assistant professor of education.

DISCUSSION AND CORRESPONDENCE

THE ORIGIN OF PACIFIC ISLAND FAUNAS

To the Editor of Science: In the current number of Science (April 14) I read with interest the abstract of a paper by Dr. Pilsbry on the land shells of the Pacific islands as a guide to former geographic conditions. The author rejects "the hypothesis that Pacific snails reached the islands by oversea drift" because it "leaves the absence of higher snails unexplained."

It is perhaps dangerous to criticize an argument from an abstract, but as this point has been cited in other cases where I know it involved a fallacy, I venture to suggest that Doctor Pilsbry may also have overlooked the fact that the older a given group is the longer time there has been for the chances of oversea dispersal, hence the greater the probability of its reaching the more remote islands. Obviously a group which has not become dominant until the later Tertiary has but a very small chance of having reached remote islands as compared with a group that was dominant during the Mesozoic or earlier. Certain features in the Mesozoic and early Tertiary climates would tend to increase greatly the chances of oversea transport, and a third explanation might be cited in the differences of habitat which would tend to facilitate the drift dispersal of some types more than others. That the higher types should be found in the larger islands and those nearer to the continental platforms is quite to be expected; and by the law of chances, where only a limited number of primary stocks of the more ancient groups have reached the more distant islands, one ought not to expect to find any of the groups of comparatively recent dominance.

With many if not most groups of land invertebrates, as with the land vertebrates, the evolution and dispersal of the modern dominant fauna took place during the Tertiary, and much of it I suspect rather late in the Tertiary. But, as also with vertebrates, the wide oceanic dispersal of the older or lower groups may be due more to their greater facilities for dispersal than to their greater antiquity.

W. D. Matthew

BELGIAN HARE, A MISLEADING MISNOMER

In a paper entitled "Anatomical Adaptations in the Thoracic Limbs of the California Pocket Gopher and Other Rodents,"[1] Charles Daniel Holliger has identified the so-called Belgian hare as *Lepus europaeus* (p. 449). At various places in the text and particularly in the last paragraph of the summary (p. 489) he comes to the conclusion that "domestication reduces specialization" and that "the typical cursorial modifications [of the Jack rabbit] have either disappeared or have been much reduced in the Belgian hare."

As a matter of fact the "Belgian hare" is a domestic variety of the European rabbit and the striking differences observed by Holliger are due to inherent generic differences, the Jack rabbit belonging to the genus *Lepus* and the European rabbit and with it the Belgian hare belonging to the rather conspicuously different genus *Oryctolagus*.[2] Or to put it the other way around, the striking differences observed by Holliger (see especially table p. 487) are part of those on which the genera *Lepus* and *Oryctolagus* are founded.

M. W. Lyon, Jr.
George Washington University

THE VAPOR PRESSURE OF SOLUTIONS

In Science of January 14 last Arthur Tabor Jones describes an apparatus for observing the change in the volume of solutions in the presence of the solvent owing to the difference in the vapor pressures. He could not determine the rate of change owing to the roughness of the bell jar. The following apparatus has

[1] *Univ. Calif. Publ.*, Vol. 13, pp. 447–497, March 7, 1916.

[2] See Lyon, *Smiths. Miscell. Coll.*, Vol. 45, pp. 323, 406, pl. 98, June 15, 1904; and Miller, Cat. Museum West. Europe Brit. Mus., p. 485, November 23, 1912.

been used by me and has proved very satisfactory.

In a foot-cylinder with a ground top is placed a smaller graduated cylinder containing the solution. The larger cylinder contains sufficient solvent to reach nearly to the top of the smaller one. The system is enclosed by a ground-glass vaselined plate covering the outer cylinder. Gradually the volume of the solution increases and the change in volume can be accurately followed and recorded.

In an experiment which lasted two months the total change in a nearly saturated salt solution was from 5.8 c.c. to 6.6 c.c., or nearly 14 per cent. This is to be repeated for verification, and other solutions of various solvents and solutes studied.

JAMES H. RANSOM

PURDUE UNIVERSITY,
March 25, 1916

SCIENTIFIC BOOKS

Engineering as a Career. A series of papers by eminent engineers, edited by F. H. NEWELL and C. E. DRAYER.

This book of 214 pages is made up of selections from the writings of different engineers so chosen as to embrace a broad field of practise. It is a mosaic presenting attractive fragments from the work of active leaders in steel-making, in manufacturing, in marine engineering, in railroad operation and maintenance, in municipal administration, in industrial management, in architecture, in mining and metallurgical work, and in other equally interesting and important lines of activity. The book opens with a general discussion of the engineer and his profession by Mr. Albert J. Himes. Mr. Worcester R. Warner speaks especially from the standpoint of the mechanical engineer, Mr. A. W. Johnston from that of the railway engineer, and Mr. Chester W. Larner from that of the hydraulic engineer. Altogether twenty-two selections are presented. They make an impressive picture drawn by men of experience, concerning the opportunities offered to and the attributes of character required by one who seeks a career as an engineer.

The book will interest parents, ambitious for the success of their growing sons, who are approaching the question as to whether their sons shall go to college, and if so, whether they shall seek to become engineers; it will interest multitudes of high-school boys, who are wavering between the call of business and that of the technical or professional school; and it will interest engineers who enjoy any well-considered formulated statement which seeks to set forth broad views of the engineer's problem and of the place which he must assume in society. But it is especially for the boy and for the parents of boys.

The editing has been a labor of love, the work having been done by Mr. C. E. Drayer, secretary and later president of the Cleveland Engineering Society, and by Professor F. H. Newell, head of the department of civil engineering of the University of Illinois, who for twenty-five years served the government in an engineering capacity, principally as chief engineer and later as director of the United States Reclamation Service which has been responsible for the building of great reservoirs and irrigation canals throughout the arid west.

W. F. M. Goss

UNIVERSITY OF ILLINOIS

The Rare Earths. By S. I. LEVY, B.A. (Cantab.), B.Sc. (Lond.), A.I.C., Late Hutchinson Research Student of St. John's College, Cambridge. Longmans, Green and Company. With illustrations. Pp. 359. Net, $3.00.

This is the first book published in English that attempts to give a fairly comprehensive account of the rare-earth group, and the magnitude of the task has resulted in a volume of considerable size.

An introduction written by Sir William Crookes, himself a master in this field of research, does much at the outset to give the book standing.

The work is divided into three parts: I. Occurrence of the Rare Earths; II. Chemistry of the Elements; III. Technology of the Elements. The author has included zirconium and titanium among the elements treated, because of their occurrence in rare-earth min-

erals. Just why columbium and tantalum do not find a place here for the same reason is not altogether clear; but of course a limit had to be set.

Part I. classifies the minerals as follows: (1) silicates; (2) titano-silicates and titanates; (3) tantalo-columbates; (4) oxides and carbonates; and (5) phosphates and halides. Such a classification of the one hundred and fifty or more rare-earth minerals, giving the percentages of the chief rare earths present, is useful and has already been adopted by other authors. A valuable addition to this list is the giving of the locality where the minerals are found.

Part II. discusses adequately and satisfactorily, on the whole, the chemistry of the elements. A fair amount of attention is given to the separation processes so many and complicated in this group. The spectroscopic methods, absorption, spark, arc and cathode luminescence, methods themselves of the highest value, are duly emphasized, and Urbain's recent application of magnetic susceptibility receives its proper consideration. It is of interest to note that the lanthanum test consisting of a blue color when iodine is brought into contact with the hydroxide find a place in the book, although no one of whom the reviewer knows has been successful in applying it.

Part III. is concerned mainly with an account of the development of the incandescent light industry. This is a most instructive history, and deserves all the space assigned to it, as it has given the main impetus to rare-earth investigation during the past thirty years.

A feature which commends the book is its international scope. American, English, French and German chemists will find their work fairly represented.

The book is an important contribution to inorganic chemistry, and should be in the library of every inorganic chemist for study or at least for reference.

Philip E. Browning

Relativity and the Electron Theory. By E. Cunningham. Longmans, Green and Company, London. Pp. vii + 96.

The author has a large work on this subject printed by the Cambridge University Press and now presents a short monograph, from which the more difficult mathematical work is omitted. The result is a book which may be read without serious effort, even by persons not specialists in the theory of relativity or in mathematical physics. The titles of the chapter are: I. Introductory; II. The Origin of the Principle; III. The Relativity of Space and Time; IV. The Relativity of the Electro-magnetic Vectors; V. Mechanics and the Principle of Relativity; VI. Minkowski's Four-Dimension Vectors; VII. The New Mechanics; VIII. Relativity and an Objective Æther. Throughout the work emphasis is laid upon the physical foundations of relativity and upon its physical consequences. Something is also said of the philosophical meaning of relativity.

The natural book with which to compare Cunningham's is Carmichael's Monograph, "The Theory of Relativity," published by John Wiley and Sons. The essential element of contrast is that Carmichael proceeds in the Euclidean fashion from definite assumptions or postulates to definite theorems; whereas Cunningham writes in the ordinary style of the physicist. The one lays greater stress on logical foundation, the other upon the physical connections of the theory. So different is the point of view that even though the results overlap to a large extent, any reader of one of the monographs would find much additional interest in reading the other. The change in the concepts of mass and time and space which is suggested by the theory of relativity is so perplexing to many persons that the reading of both these texts will be none too much to allay their anxieties. The mathematician should begin with Carmichael and the physicist with Cunningham.

Edwin Bidwell Wilson

SPECIAL ARTICLES

THE RELATION OF OSMOTIC PRESSURE AND IMBIBITION IN THE LIVING MUSCLE

1. A series of independent observations by Nasse, the writer, Overton, Meigs, Beutner,

v. Körösy, and probably others, have shown that the striped living muscle of a frog neither loses nor absorbs water when put into the solution of any sugar or neutral salt whose osmotic pressure is equal to that of a *m*/8 NaCl solution, provided the salt does not injure the membrane.[1] If the solution surrounding the muscle has a higher osmotic pressure the muscle will lose water, if it has a lower one the muscle will take up water. The normal, living muscle acts, therefore, as if it were surrounded by an ideal semipermeable membrane which allows water to pass through while it is impermeable for the neutral salts or sugars. The accuracy with which the muscle responds to slight changes in the osmotic pressure of the surrounding solution in the neighborhood of the isotonic point is so great that this response might be used to determine roughly the molecular weight of sugars or neutral salts. Since there is only one variable in which the isosmotic solutions of different sugars and salts of the same osmotic pressure agree, namely the number of molecules in the unit volume of the solution, we are forced to assume that the osmotic pressure is the driving force for the exchange of water between muscle and surrounding solution, provided that the surrounding solution does not destroy the semipermeability. This is not only true for the striped muscle, but also for the nerve (A. P. Mathews), for the excised kidney (Siebeck), for the red corpuscles (Hedin and others), for the sea-urchin egg (Loeb), and probably generally. The only exception known is the smooth muscle (Meigs).

2. In 1898 the writer[2] called attention to the rôle of acid formation in the muscle upon the absorption of water. He had found that if the muscle lies for a number of hours in an isotonic solution of NaCl the muscle begins to absorb small quantities of water (p. 462) and he ascribed this effect to the formation of acid (p. 464), probably lactic acid, in the muscle. He also interpreted the rapid absorption of water by an active muscle in an isotonic solution to an absorption of water due to an acid formation, and he pointed out that absorption of water due to acid formation might play a rôle in phenomena of growth (p. 466) as well as in certain phenomena of edema (p. 467 ff.). The main phenomena of edema discussed by the writer in his paper have since been shown by Moore to be due to circulatory disturbances.[3]

The question remains, how the formation of lactic (or any other) acid can increase the absorption of water in the muscle. The writer assumed that this was due to an increase in the osmotic pressure of the muscle as a consequence of the acid formation; and this idea is, as he believes, correct. The only point in which his views as expressed in 1898 may require a modification concerns the way in which the formation of lactic acid (or of acid in general) increases the osmotic pressure of the muscle. In 1898 he assumed that the hydrogen ion acted like a hydrolytic ferment and increased the number of molecules in solution in the muscle by splitting certain larger molecules into smaller ones. This is, of course, *a priori* possible, but not proven in this case. A second possibility is the increase of the osmotic pressure of certain colloids under the influence of acid as observed by R. Lillie, Moore and Roaf, and others. A third possibility is connected with the explanation of imbibition given by the work of Procter, Pauli, and very recently Katz. According to this work we may assume that through a chemical combination of the acid with a protein the latter forms definite hydrates with water, in which process a diminution of volume with heat production occurs. If acid is formed in the muscle the proteins of the latter combine with the acid and with water. The number of molecules of water which one molecule of acid-protein (or rather one protein-cation) can bind seems considerable. This water is taken not from the outside, but from the solution inside the muscle. As a consequence of this

[1] A fuller discussion of these experiments is found in SCIENCE, 1913, XXXVII., 427.

[2] Loeb, J., *Arch. f. d. ges. Physiol.*, 1898, LXXI., 457.

[3] Moore, A. R., *Am. Jour. Physiol.*, 1915, XXXVII., 220.

withdrawal of water the solution inside the muscle becomes more concentrated and assumes a higher osmotic pressure than that of a $m/8$ NaCl solution. Hence if such a muscle is surrounded by a $m/8$ NaCl solution the difference in osmotic pressure of the solution inside and outside the muscle must lead to a diffusion of water into the muscle.

The *direct* driving force for the exchange of water between muscle and surrounding solution is, therefore, again the osmotic pressure.

3. These ideas are so self-evident that their publication would seem superfluous were it not for the fact that Wolfgang Ostwald and other colloid chemists deny the existence of semipermeable membranes in the muscle on account of the fact that acid causes proteins to undergo imbibition. It seemed, therefore, of some importance to point out that the imbibition of the proteins of a muscle under the influence of acid formed inside contradicts neither the existence of a semipermeable membrane around the striped muscle nor the paramount rôle of osmotic pressure in the exchange of water between such a muscle and its surrounding solution.

Jacques Loeb
The Rockefeller Institute
for Medical Research,
New York

SOCIETIES AND ACADEMIES

THE KANSAS ACADEMY OF SCIENCE

The forty-eighth annual meeting was held in Memorial Hall at Topeka, Kansas, January 14 and 15, 1916. The following, among other papers, were read:

"Civilized Europe: a Chapter in Anthropology," by A. A. Graham.

"Botanical Notes," by L. C. Wooster.

"Some Experiments with *Bacillus coli communis*," by L. C. Wooster.

"Observations on Jupiter at Opposition in 1915," by Edison Pettit.

"A Universal Heliostat," by Edison Pettit.

"Additions to Kansas Coleoptra, to 1916," by W. Knaus.

"Some Life History Notes on *Phytonomus eximins*," by W. Knaus.

"Rare Coleoptra from the Sand Hill Region of Reno County," by W. Knaus.

"The Clan System of Wyandot Indians," by William E. Connelley.

"Echinacea and its Use," by J. M. McWharf.

Presidential Address—"American Highways," by J. A. G. Shirk.

"Properties of Kansas Clays," by Paul Teetor.

"Notes on the Comanchian of Kansas," by W. H. Twenhofel.

"Relative Toxicity of Aromatic Oils and Inorganic Compounds on Fungi," by L. J. Reiser.

"The Gorship Indians of Utah," by A. B. Reagan.

"Some Nutritional Characteristics of Corn," by J. T. Willard.

"The New Public Health," by J. C. Crumbine.

"A Study of Foods for Infants," by Leon A. Congdon.

"Stramonium," by L. D. Havenhill.

"The Chemical Products of Physical Fatigue and their Possible Relation to Mental Efficiency," by F. C. Dockeray.

"A Method for the Determination of Salicylic Acid in Aspirin," by G. N. Watson.

"Isolation of the Toxic Principles of Coffee and Determination of their Toxicity," by L. E. Sayre.

"Calcium Metabolism," by C. F. Nelson.

"Differentiation within the Acid-fast Group of Organisms," by N. F. Sherwood.

"Breeding Habits of some Annelids," by W. J. Baumgartner.

"Eugenic Studies in Kansas," by W. R. B. Robertson.

"Effect of Environment upon the Germ Cells," by B. M. Allen.

"Population Changes and Industrial Development," by P. F. Walker.

"Explosions in Kansas Coal Mines: Their Cause and Prevention," by A. C. Terrill.

"More about Kaw Lake," by J. E. Todd.

"Eolian Loess," by J. E. Todd.

"On the Occurrence of Starch in some Green Fruit Products used for Jelly-making," by E. H. S. Bailey and W. S. Long.

"The Chemical Characteristics of Ground Water," by F. W. Bruckmiller.

"Experimental Modifications in the Development of the Germ Glands of the Frog," by W. W. Swingle.

The officers elected were as follows: J. E. Todd, *President;* F. G. Agrelius and L. D. Havenhill, *Vice-presidents;* W. W. Swingle, *Secretary;* and Wm. A. Harshbarger, *Treasurer.*